Glasgow

THE GLASGOW

MECHANICS' MAGAZINE;

AND

ANNALS OF PHILOSOPHY.

VOL. II.

GLASGOW:
W R. M'PHUN, PUBLISHER.

1825.

JAMES CURLL, PRINTER.

TO THE

MECHANICS OF GLASGOW,

WHOSE

THEORETICAL INGENUITY AND PRACTICAL EXCELLENCE ARE

ACKNOWLEDGED OVER THE WHOLE WORLD,

THIS VOLUME

OF THE

GLASGOW MECHANICS' MAGAZINE,

IS DEDICATED,

BY THEIR OBLIGED AND HUMBLE SERVANTS,

THE EDITORS.

PREFACE.

THE Second Volume of this Magazine has now been brought to a close; and it affords us the highest satisfaction to be able to announce the favourable auspices under which it is concluded.

The benefits resulting to all classes of society, and particularly to artizans, from the weekly publication of such a work as ours, are already too well known, and too highly appreciated, to require any farther illustration from us. Its *cheapness* is of great importance to those whose desire for knowledge is beyond their means of attaining it in more bulky and more expensive works: the smallness of its size entices many to read, who, from want of time or inclination, seldom think of opening a large book; and it has all the advantages of a larger journal, as it is read, by those who prefer it, either in monthly or quarterly parts. It is, besides, "the *cheapest* and *best got up*" publication of the kind which has yet appeared;—even this superiority has been acknowledged by our London contemporaries.

Indeed, the unprecedented circulation with which it has been honoured, the daily additions which are making to the list of its subscribers, and the cordial warmth with which it is everywhere received, afford the best evidence of the public opinion with regard to its utility which can be offered, and form a strong incentive to renewed exertion. Every endeavour has been made to make improvements; and the Editors have the prospect of being enabled to make many improvements in the course of the volume about to be commenced, which they humbly

conceive will greatly enhance the value of the work of which they have the superintendence. It is impossible at present to enter into all they mean to do; but they may state that, among others, they intend, under the title of "The Chemist," to set apart a portion of their Magazine for the science of Chemistry. It is very unnecessary, they should suppose, to state any thing in favour of this alteration; the importance of Chemistry, as a science, being too well known to require it.

To the public in general, who have so liberally patronised our labours, and to the many kind and ingenious correspondents who have assisted us with their valuable contributions, we beg to return our most unfeigned thanks. We solicit, and hope still to receive, a continuation of all their kindnesses and all their favours; and we doubt not, that we shall thereby be enabled to continue to extend the circulation of "The Glasgow Mechanics' Magazine," and thereby enlarge and increase the sphere of its usefulness.

To the Mechanics of Glasgow, we would be wanting in kindness and attention, did we not return our warmest acknowledgements for the support they have so liberally given us, and the interest so many of them have taken in our success. We trust they will still continue to assist us with their contributions, that the Magazine which bears their name, may continue to be worthy of the high character which they bear over the world.

155, Trongate, *5th February*, 1825.

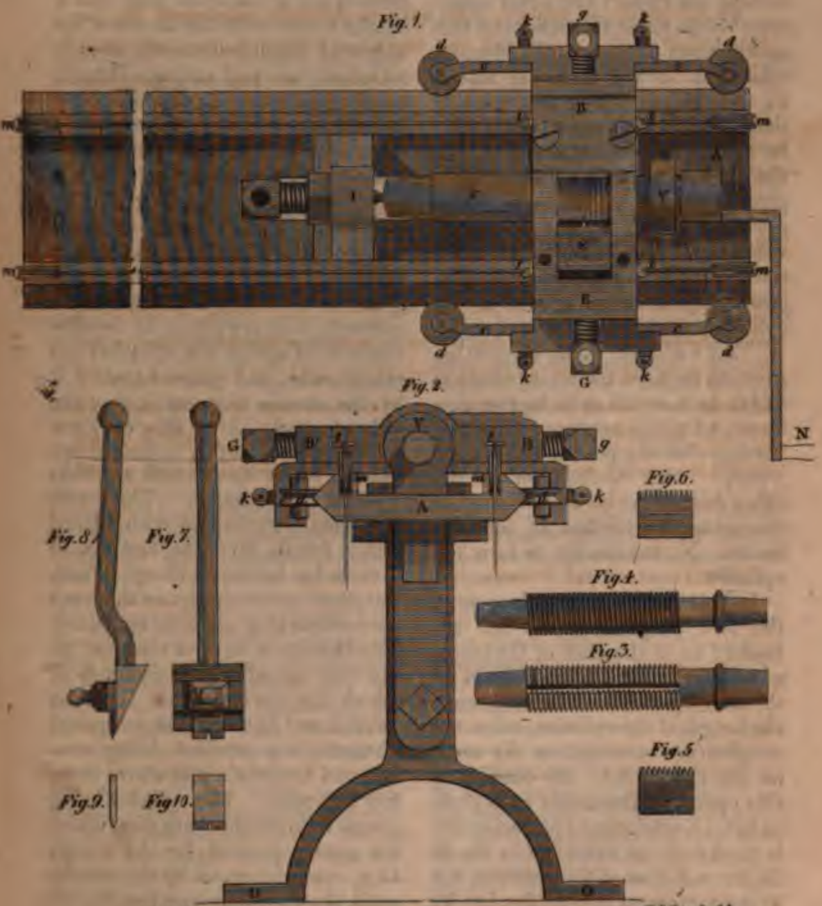
THE GLASGOW
MECHANICS' MAGAZINE.

"*England!* with all thy faults, *I love* thee still!"—*Cowper.*

No. XXX. *Saturday*, 24*th July*, 1824. Price 3*d*.

MACHINE FOR MAKING AN ORIGINAL AND PERFECT SCREW,

Invented by Mr. Angus Mackinnon, *Glasgow.*



A. Watt, Del. H. Wilson Sculp^t

MACHINE FOR MAKING AN ORIGINAL AND PERFECT SCREW.

Invented by Mr. Angus Mackinnon, Glasgow.

Fig. 1 is a plan, and fig. 2 is an end view of the machine for constructing the screw.

A A is the cast-iron bar, upon which the die-frame, B B, is made to move. *c c c c*, two strong springs, attached to the die-frame, having rollers, *d d d d*, in each end, moving upon the angular parallel edges of the bar, A A. E, a small frame for holding the cutter; the cover being removed to show the action of the cutter upon the steel cylinder, of which the screw is to be made. F, the steel cylinder; the point of the cutter, (which must be adjusted to an angle, varying according to the pitch of thread wanted,) is seen projecting from the frame E, being pressed forward by the screw G. One end of the cylinder F, acts upon the centre in the head-stock I. The journal upon the other end of the cylinder, works into the steel collar V. *k k k k*, four small screws for pressing forward the springs *c c c c*. *l l l l*, four small eyes in the die-frame, to which cords are attached, passing over the pulleys *m m m m;* weights being hooked on at the other ends of the cords, sufficient to overcome the friction of the die-frame. N, the handle to turn the cylinder.

In beginning to make the screw, the two weights to the left are hooked on to the ends of the cords, and the cylinder is turned round by the handle, until the cutter traverses the length of the cylinder, when the weights are removed to the cords on the right hand. By continuing this operation alternately from right to left, an original and perfect screw is produced, as exhibited in fig. 3. In the end view of the machine, fig. 2, *o o* represents one of the feet by which it is fastened to a bench. *The same letters refer to* the same parts of the machine in both figures where those parts are exhibited.

Having obtained, as already described, one screwed cylinder; this is removed, and another of the same size is put into the machine. The same operation is performed on it as on the last; but it is not screwed to a full thread, the sharp cutter being removed when the spaces and threads are of an equal size, and a square cutter is put in its place, by means of which is obtained, what is technically termed a square thread, as shown in fig. 4. In the same manner, a third, and a fourth cylinder are screwed, each being successively a degree smaller than the preceding. The small frame holding the cutter is now removed, and replaced with dies, a set of which is to be screwed with each of the above cylinders. When the dies are to be screwed, they are placed in the die-frame with one of the cylinders already made, and pressed against it by the screws G *g*, until they are fully screwed. After this, they are replaced with another cylinder, and another set of dies, which are likewise to be screwed. The same operation is performed with a third and a fourth set; (the first set of dies *only*, having a sharp thread, the other set having square threads,) after which they are to be tempered. The headstock is now removed to the left, to admit the cylinder of which the perfect screw is to be formed, and fastened at any required distance, the machine being constructed to cut a screw above three feet in length. The cylinder being placed between the sharp dies, which are gently pressed by the screws G *g*, is turned round by the handle, until the die-frame reaches the left hand of the cylinder; it is then turned in the contrary way, and

worked in the same manner as when using the cutter. When a square thread screw is to be made, the sharp dies must be removed after the indentation is sufficiently deep to admit the square dies, which are to be substituted for the former; when these have cut the screw to a considerable depth, a smaller set of square dies is taken in succession, until the screw is finished.

N. B. Figs. 7 and 8 represent a small stock, made of steel, and hardened, for holding the cutter while sharpening. Figs. 9 and 10, represent an edge and side view of the cutter. Figs. 5 and 6, represent the dies.

Angus Mackinnon.

Glasgow, 24th July, 1824.

SKETCH OF THE LIFE OF ARKWRIGHT.

THE general fate of inventors has been singularly unfortunate. Of those men who have added to the wealth and prosperity of their country by new improvements in the arts, many have struggled through life with poverty and neglect, and but a small number have been so successful as to enjoy in their own persons the fruits of their exertions. Even when their station in society is respectable, the difficulties of introducing any new improvement are always considerable, and too often lead to embarrassment and ruin. If they finally succeed, envy denies them the merit of their inventions—avarice seeks to deprive them of their well-merited recompence—and the tricks of trade or the chicanery of law strive which shall be most successful in rendering their labours of no avail. Inventors sow the seed, but they rarely reap the harvest. To this melancholy result of ingenuity and perseverance, Arkwright was a splendid exception. Not that he too had his full share of the dangerous concomitants of merit: his original station was humble, his talents were long exerted without the aid of others, his efforts often frustrated by ignorance and malice; and even when he rose superior to difficulty, his rights were sometimes put aside by the technicalities of law, and remained almost always unacknowledged; calumny was busy with his name, and envy pointed at him as the fraudulent collector of the inventions of others. But he lived to see the mist disappear that had been raised by envy and malevolence—he rose to an opulence almost princely—and at last heard himself universally acknowledged as a *benefactor to his country.*

Richard Arkwright was born at Preston, in Lancashire, in the year 1732. He was the youngest of *thirteen* children. He was brought up to the occupation of a barber, and supported himself by this employment till he was more than thirty years of age. We are not informed of the peculiar circumstances that first directed his attention to the cotton manufacture; but it seems probable that his residence in a manufacturing district gave him some knowledge of the common mechanical processes, and that he took an interest in the complaints made by his neighbours of the deficient supply of *cotton yarn*. Almost the only part of England where the cotton manufacture was introduced, was Lancashire, and there all the processes of art were extremely defective. Down to the year 1765, *calicoes*, then and now one of the staple fabrics of that wealthy district, were obliged to be made of *linen warp*, as cotton could not be spun *long enough* for the purpose. But the ingenuity of the people was now at work; changes were daily introduced, and in this, as well as other manufactures, England began that prodigious career of improvement by which she has ever since distanced the rest of Europe.

A weaver in Lancashire, named *James Hargreave*, introduced considerable improvements into the cotton manufacture by the invention of a new mode of *carding*, and afterwards by the *spinning-jenny*. The spinners took alarm, lest their numbers should be diminished by the invention: as usual, they combined to put down *innovation*; they destroyed his establishment; and forced him to remove to Nottingham. Other combinations were formed against him there; and it

is melancholy to relate that this ingenious man died soon afterwards, *in great misery*. While Hargreave was encountering poverty and persecution, Arkwright was making trials to change the process of spinning then in use, but from his want of mechanical skill, had great difficulties in getting any machine, or combination of machinery, to answer the idea he had formed in his mind. It was long after this period before his plans were brought into practice; and, indeed, it is confidently asserted that he *borrowed* his inventions from others. We shall briefly state the substance of the allegations brought against his originality.

In the year 1767, Arkwright had given up his business as a barber, and was travelling through the country for the purpose of buying hair. He came to Warrington, formed an intimacy with a watch-maker named John Kay, and showed some plan of his towards obtaining *perpetual motion*. Kay ridiculed his idea, and told him that his ingenuity might be better employed in finding out some method of spinning to supersede the common one-thread wheel. Kay had formerly been employed to make a spinning-engine for a Mr. Hayes, and the knowledge he had acquired by this means he *communicated* to Arkwright. The mechanical knowledge of the latter was but slender, while Kay, as might be presumed from his business as a watch-maker, was well acquainted with machinery and mechanical combinations. *Kay* and Arkwright made a machine in conjunction; but the merit of the *first* suggestion of the principle, *it is said*, is attributable to Kay.

Such is the account that ascribes the *invention* to Kay, and merely the *improvement* of the machinery to Arkwright. But it must be observed, in the first place, that the machine which Kay constructed for Mr. Hayes did *not* succeed; and it is well-known that many others besides Hayes were at this time engaged in making experiments to change the mode of spinning. The *carding engine* had lately been introduced, and the necessity of expediting the process of spinning had led to all sorts of mechanical experiments:—but all these were uniformly *unsuccessful*. If Arkwright borrowed his notions from another, it is singular that he should have been engaged for so many years afterwards in bringing his improvement to any degree of perfection. Had Kay's *communication* been at all important, it is highly unlikely that Arkwright would have had so many difficulties to encounter in bringing his machine into practical operation; nor would he have required so much pecuniary aid, nor so much important information from skilful mechanics, as we know that he received. From the time that Mr. Arkwright began his experiments on spinning, till he brought his machinery to perfection, *five* years elapsed, and he expended more than *twenty thousand pounds*, without receiving any return. This money was, of course, advanced by others, by those who had confidence in his integrity, as well as his talents;—his rivals (as usual) reproached him in after life with having made his fortune by means of *borrowed capital*, and employed against him all those invidious reflections that are aimed at those whose success raises them above the dead level of mediocrity.

Mr. Arkwright now entered into partnership with Mr. Smalley of Preston, (his native place;) but, as occurred to the unfortunate Hargreave, the spinners rose to put down their machinery—their establishment was ruined, and they were both forced to remove to Nottingham. At this place he persuaded two bankers of the name of Wright, to advance him considerable sums for the purpose of bringing his machinery to perfection. But when they found the advances becoming heavier than they had anticipated, and the success doubtful, they advised him to get Mr. Need, an eminent stocking manufacturer, to take *their interest* in his establishment off their hands. When Mr. Need was applied to, he referred Arkwright to his partner, Mr. Shute, and said he would be guided by his opinion of the utility of the improvement. Shute was a man of great mechanical skill: he saw at a glance the advantages of the proposed plan, and the facility with which any of its remaining defects might be obviated. The advances of the Messrs. Wrights were repaid to them, and Messrs. Shute and Need entered into partnership with Mr. Arkwright, for the purpose of *spinning cotton with rollers*. He took out a patent for his *spinning frame* in 1769, and erected a mill at Nottingham to be set in motion by *horses*. In 1771, at Cromford, in Derbyshire, he erected another mill to be moved by *water*.

The *spinning frame* has justly been

held to be a wonderful invention. It has nothing in common with the spinning wheel, except that it performs the same process. The machinery for drawing and spinning the cotton was his grandest conception—all his subsequent inventions, though of great importance, did not require the same originality of mind, as they were rather improvements and combinations of his former invention than new ideas. It is said that Arkwright obtained the first idea of his improvements from seeing the action of the common rolling mill in iron-works, and conceived that a system of rollers might be so adapted as to perform the operations of spinning. It is certain that the first *patent* he obtained, was for the improvement he called the *water spinning frame*, and that upon the principles of this machine all his subsequent improvements were founded.

While Mr. Arkwright was beginning to enjoy some of the benefits of his inventions, his patent was contested in 1772, on the ground that his improvements were *not original*; every effort of malice and envy was exerted to resist his rights; but he prevailed over all opposition, and from this time henceforth, *this patent* was no more disputed. He made farther improvements in the machinery for preparing cotton, and brought his whole *spinning frame* to its highest state of perfection in 1775; but the patent he took out was again disputed; and, after a litigation of several years, his rights were set aside, under the pretext that *all the mechanical applications combined with it* were not original—and his patent was cancelled in the year 1785.

Though his patent was cancelled, Mr. Arkwright now enjoyed the full tide of prosperity. Wealth flowed profusely into his lap; and, if his first difficulties were many, his final success was cheering. He was for a short time in partnership with David Dale, Esq. of the *Lanark Cotton Mills*. His spinning machines were spreading over the kingdom, and he received an annual sum—*the tribute* of invention it might be called—for each spindle employed. His success raised him enemies, whom his irritability of temper did not tend to conciliate; while his competitors in the struggle for wealth meanly taunted him with the lowness of his original station, and thereby showed that *they* would never have emerged from obscurity had such been their lot. It was in allusion to his original occupation, and to his connection with Mr. Dale, that he is reported to have said of his enemies—that "he would put his razor into the hands of a Scotchman who would *shave* them all." He was particularly friendly to Scotchmen, and gave them free access to his establishments.

The improvements introduced by Watt into the steam engine, now rendered it of primary importance in giving motion to machinery, and the benefit of Arkwright's inventions were soon rapidly extended by its application to cotton spinning. The first steam engine erected by *Boulton and Watt*, for Arkwright, was in the year 1790, at Cromford, in Derbyshire.

We have little interesting to relate concerning the remaining incidents of the life of Arkwright. On the 22d December, 1786, he received the honour of *Knighthood*, on presenting an address to his Majesty from the Sheriff and Hundred of Wicksworth. He died at his seat at Cromford, in Derbyshire, on the 3d August, 1792.

Sir Richard Arkwright was of a hasty and capricious temper; and, though a man of great powers of mind, he could never entirely shake off the rude habits of early life, nor adopt the sentiments which befitted the rank to which his talents had raised him. The benefit which England has derived from *his improvements* may be conceived, when we look back to the rudeness and infancy of the cotton manufacture *fifty* years ago; and, when we find, that at the present moment, next to agriculture, it is the *most important and most extensive* occupation in which the inhabitants of this country are engaged. The value of the cotton goods manufactured in Great Britain amounts to the enormous sum of *forty millions a-year, twenty millions* of which are exported. Nearly *six* millions' worth of cotton goods are annually manufactured in *this city* and neighbourhood. Every country in Europe has participated in the benefit of the *spinning frame*. In fact, *the extension of the cotton manufacture* that has been accomplished by *Arkwright* and his successors, is an incident altogether unprecedented in the history of commerce.

X.

Glasgow, 17th July, 1824.

ABSTRACT OF THE ACT
For Ascertaining and Establishing Uniformity of WEIGHTS *and* MEASURES.

[Cap. 74. G. R. IV.—Passed 17th June, 1824.]

FOR the security of Commerce, and for the good of the community, &c. &c. be it therefore enacted, That from and after the first day of May, one thousand eight hundred and twenty-five, the Straight line or distance between the centres of the two points in the gold studs in the straight brass rod, now in the custody of the Clerk of the House of Commons, whereon the words and figures "Standard Yard, 1760," are engraved, shall be, and the same is hereby declared to be, the original and genuine standard of that measure of length or lineal extension called a Yard; and that the same straight line or distance between the centres of the said two points in the said gold studs in the said brass rod, the brass being at the temperature of sixty-two degrees by Fahrenheit's thermometer, shall be, and is hereby denominated, the "Imperial Standard Yard," and shall be, and is hereby declared to be, the unit or only standard measure of extension, wherefrom or whereby all other measures of extension whatsoever, whether the same be lineal, superficial, or solid, shall be derived, computed, and ascertained; and that all measures of length shall be taken in parts or multiples, or certain proportions of the said standard yard; and that one-third part of the said standard yard shall be a foot, and the twelfth part of such foot shall be an inch; and that the pole or perch in length shall contain five such yards and a half, the furlong two hundred and twenty such yards, and the mile one thousand seven hundred and sixty such yards.

II. That all superficial measure shall be computed and ascertained by the said standard yard, or by certain parts, multiples, or proportions thereof; and that the rood of land shall contain one thousand two hundred and ten square yards, according to the said standard yard; and that the acre of land shall contain four thousand eight hundred and forty such square yards, being one hundred and sixty square perches, poles, or roods.

III. And whereas it is expedient that the said standard yard, if lost, destroyed, defaced, or otherwise injured, should be restored of the same length, by reference to some invariable natural standard: And whereas it has been ascertained by the Commissioners appointed *by His Majesty to inquire into the subject of Weights and Measures,* that the said yard hereby declared to be the imperial standard yard, when compared with a pendulum vibrating seconds of mean time in the latitude of London, in a vacuum at the level of the sea, is in the proportion of thirty-six inches to thirty-nine inches, and one thousand three hundred and ninety-three ten-thousandth parts of an inch; be it therefore enacted and declared, That if at any time hereafter the said imperial standard yard shall be lost, or shall be in any manner destroyed, defaced, or otherwise injured, it shall and may be restored by making, under the direction of the Lord High Treasurer, or the Commissioners of His Majesty's Treasury of the United Kingdom of Great Britain and Ireland, or any three of them, for the time being, a new standard yard, bearing the same proportion to such pendulum as aforesaid, as the said imperial standard yard bears to such pendulum.

IV. And be it farther enacted, That from and after the first day of May, one thousand eight hundred and twenty-five, the standard brass weight of one pound troy weight, made in the year one thousand seven hundred and fifty-eight, now in the custody of the Clerk of the House of Commons, shall be, and the same is hereby declared to be, the original and genuine standard measure of weight, and that such brass weight shall be, and is hereby denominated, the Imperial Standard Troy Pound, and shall be, and the same is hereby declared to be, the Unit or only Standard Measure of Weight, from which all other weights shall be derived, computed, and ascertained; and that one-twelfth part of the said troy pound shall be an ounce; and that one-twentieth part of such ounce shall be a pennyweight; and that one-twenty-fourth part of such pennyweight shall be a grain; so that five thousand seven hundred and sixty such grains shall be a Troy pound, and that seven thousand such grains shall be, and they are hereby declared to be, a pound Avoirdupois, and that one-sixteenth part of the said pound Avoirdupois shall be an ounce Avoirdupois, and that one-sixteenth part of such ounce shall be a dram.

V. And whereas it is expedient, that the said Standard Troy Pound, if lost, destroyed, defaced, or otherwise injured, should be restored of the same weight, by reference to some invariable natural standard: And

whereas it has been ascertained, by the Commissioners appointed by His Majesty to inquire into the subjects of Weights and Measures, that a cubic inch of distilled water, weighed in air by brass weights, at the temperature of sixty-two degrees of Fahrenheit's thermometer, the barometer being at thirty inches, is equal to two hundred and fifty-two grains and four hundred and fifty-eight thousandth parts of a grain, of which, as aforesaid, the Imperial Standard Troy Pound contains five thousand seven hundred and sixty; be it therefore enacted, That if at any time hereafter the said Imperial Standard Troy Pound shall be lost, or shall be in any manner destroyed, defaced, or otherwise injured, it shall and may be restored by making, under the directions of the Lord High Treasurer, or the Commissioners of His Majesty's Treasury of the United Kingdom of Great Britain and Ireland, or any three of them for the time being, a new Standard Troy Pound, bearing the same proportion to the weight of a cubic inch of distilled water, as the said Standard Pound hereby established bears to such cubic inch of water.

VI. And be it farther enacted, That from and after the first day of May, one thousand eight hundred and twenty-five, the Standard Measure of Capacity, as well for liquids as for dry goods not measured by heaped measure, shall be the Gallon, containing Ten pounds Avoirdupois weight of distilled water weighed in air, at the temperature of sixty-two degrees of Fahrenheit's thermometer, the barometer being at thirty inches; and that a measure shall be forthwith made of brass, of such contents as aforesaid, under the directions of the Lord High Treasurer, or the Commissioners of His Majesty's Treasury of the United Kingdom, or any three or more of them for the time being; and such Brass Measure shall be, and is hereby declared to be, the Imperial Standard Gallon, and shall be, and is hereby declared to be, the Unit and only Standard Measure of Capacity, from which all other measures of capacity to be used, as well for wine, beer, ale, spirits, and all sorts of liquids, as for dry goods not measured by heap measure, shall be derived, computed, and ascertained; and that all measures shall be taken in parts or multiples, or certain proportions of the said Imperial Standard Gallon; and that the quart shall be the fourth part of such Standard Gallon, and the pint shall be one-eighth of such Standard Gallon, and that two such gallons shall be a peck, and eight such *gallons shall be a bushel,* and eight such bushels a quarter of corn or other dry goods, not measured by heaped measure.

VII. And be it further enacted, That the Standard Measure of Capacity for coals, culm, lime, fish, potatoes, or fruit, and all other goods and things commonly sold by heaped measure, shall be the aforesaid Bushel, containing eighty pounds Avoirdupois of water as aforesaid, the same being made round with a plain and even bottom, and being nineteen inches and a half from outside to outside of such Standard Measure as aforesaid.

VIII. And be it further enacted, That in making use of such Bushel, all coals and other goods and things commonly sold by heaped measure, shall be duly heaped up in such Bushel, in the form of a cone, such cone to be of the height of at least six inches, and the outside of the Bushel to be the extremity of the base of such cone; and that three bushels shall be a sack, and that twelve such sacks shall be a chaldron.

[In the following articles, the title is, in general, all that we have given.]

IX. Measure of weight, or heaped measure, to be used for coals, culm, lime, fish, potatoes, and fruit. For other articles, weight or stricken measure.

X. Not to authorize selling by measure of articles required to be sold by weight in Ireland.

XI. Copies and models of the Standard of Length, Weight, and Measure, to be made and verified under direction of the Treasury, within three months after the passing of this act.

XII. Models and copies to be provided for counties, ridings, or divisions, shires or stewartries, cities, towns, or places, cities or royal burghs, by Justices or Magistrates.

XIII. Expenses of procuring the same, to be paid in *England* out of the rates, in *Scotland* by assessment, and in *Ireland* by presentments to be made by Grand Juries.

XIV. And be it enacted, That in all cases of dispute respecting the correctness of any measure of capacity, arising in a place where recourse cannot be conveniently had to any of the aforesaid verified copies or models of the standard measures of capacity, or parts or multiples of the same, it shall and may be lawful to and for any Justice of the Peace or Magistrate having jurisdiction in such place, to ascertain the content of such measure of capacity by direct reference to the weight of pure or rain water which such measure is capable of containing, &c.

XV. After 1st May, 1825, all contracts for sale, &c. by weight or measure

shall relate to the standard, unless the contrary is specified.

XVI. Existing weights and measures may be used, (till worn out,) being marked so as to show the proportion they have to the standard measures and weights.

XVII. For ascertaining contracts or rents payable in grain or malt, &c. in *England* and *Ireland*, an inquisition shall be taken before the Justices assembled at a general or quarter sessions.

XVIII. For ascertaining rents, stipends, feu duties, rents, tolls, customs, casualties, &c. payable in grain or malt, &c. in Scotland, the Sheriff shall summon and impannel a Jury of the same number, and with the same qualifications, which are required in the Jury who strike the fiar prices of grain.

XIX. Tables of equalization to be made, showing the proportions between the Weights and Measures heretofore in use, and the Weights and Measures hereby established.

XX. Tables to be constructed for the collection of the customs and excise, &c.

XXI. Regulations and penalties of British Acts, *viz.*—29 Geo. 2d, c. 25; 31 Geo. 2d, c. 17; 35 Geo. 3d, c. 102; 55 Geo. 3d, c. 43; shall be applied to this Act.

XXII. Regulations and penalties of the following Acts, *viz.*—4 Ann. (I.); 11 Geo. 2d, (I.); 25 Geo. 2d, (I.); 27 Geo. 3d, (I.); 28 Geo. 3d, (I.); shall be applied to this Act.

XXIII. So much of former Statutes, Ordinances, or Acts, as relate to establishing weights or measures, repealed, *viz.* Statutes of uncertain date; 14 Ed. 3d, c. 12; 14 Ed. 3d, c. 21; 18 Ed. 3d, st. 2, c. 4; 25 Ed. 3d, st. 5, c. 9, 10; 27 Ed. 3d, st. 2, c. 10; 31 Ed. 3d, st. 1, cc. 2, 5; 34 Ed. 3d, c. 5; 4 Rich. 2d, c. 1; 13 Rich. 2d, st. 1, c. 9; 15 Rich. 2d, c. 4; 16 Rich. 2d, c. 3; 1 Hen. 5th, c. 10; 2 Hen. 6th, c. 11; 8 Hen. 6th, c. 5; 9 Hen. 6th, c. 6; Id. c. 8; 11 Hen. 6th, c. 8; 18 Hen. 6th, c. 17; 22 Ed. 4, c. 2; 1 Rich. 3d, c. 13; 7 Hen. 7th, c. 4; Id. c. 8; 11 Hen. 7th, c. 4; 12 Hen. 7th, c. 5; 23 Hen. 8th, c. 4; 24 Hen. 8th, c. 6; 12 Eliz. (I.); 13 Eliz. c. 11, in part; 23 Eliz. c. 8, in part; 43 Eliz. c. 14; 16 Chas. 1st, c. 19; 12 Chas. 2d, c. 23, in part; 22 Chas. 2d, c. 8; 22, 23 Chas. 2d, c. 12; 1 Wm. and Mary, st. 1, c. 24, in part; 5, 6 Wm. and Mary, c. 7, in part; 7 Wm. 3d, (I.); 7, 8 Wm. and Mary, c. 31, in part; 9, 10 Wm. 3d, c. 6; 10, 11 Wm. 3d, c. 21, in part; 10, 11 Wm. 3d, c. 22, in part; 11, 12 Wm. 3d, c. 15; 1 Ann. st. 1, c. 15, in part; Id. c. 21, in part; 2 Ann. (I.); 5, 6 Ann. c. 27, in part; 9 Ann. c. 6, in part; 9 Ann. c. 15; 10 Ann. c. 6; 1 Geo. 2d, (I.) in part; 8 Geo. 2d, c. 12, in part; 9 Geo. 2d, (I.); 24 Geo. 2d, c. 31, in part; 26 Geo. 3d, (I.); 38 Geo. 3d, c 89; 43 Geo. 3d, c. 69.

XXIV. Act not to extend to repeal 31 Geo. 2d, c. 17, which empowers the Dean and High Steward of Westminster, &c. to appoint a proper officer to size and seal weights and measures.

XXV. Tuns, pipes, or other vessels of wine, oil, honey, and other gaugeable liquors imported into London, shall be liable to be guaged as heretofore by the Lord Mayor or his Deputies; but the contents shall be ascertained by the standard measure directed by this Act.

XXVI. Act not to affect the privileges of the City of London as to the office of guager of wines, &c.

[Some observations on this important Act will be given in our next.]

ABSTRACT OF THE THIRD REPORT

OF THE

Directors of the EDINBURGH SCHOOL OF ARTS, *for the Instruction of Mechanics*, 1*st June*, 1824.

WE feel great pleasure in presenting to our readers the following abstract, which we have given very fully, as we are convinced that it must not only be interesting but useful. The laudable exertions *that are made in this* institution, to *impart to Mechanics* a knowledge of the Mathematical Sciences, particularly deserve commendation, as it is only from an accurate knowledge of first principles, that any great or lasting improvements can be expected to be made in the Arts. Too little attention to this branch of knowledge, has perhaps

rendered the valuable lectures that are annually delivered in the Glasgow Institutions, less interesting and useful than they might otherwise have been. We trust, however, that, with the excellent example of their Edinburgh brethren before their eyes, they will not be slow in making similar advances in the most useful of the sciences.

In presenting to the Subscribers, the Report of the proceedings of the School of Arts, during the third year of its progress, we have great satisfaction in being able to announce its continued success, both as regards the value attached to it by the operative Mechanics of Edinburgh, and the increased conviction on the part of the public, that its design is calculated to add to the prosperity, the respectability, and consequently to the happiness, of a great and important portion of the community.

Since the last Annual General Meeting, several Institutions of a similar nature have been formed in different towns, both in England and in Scotland; and we flatter ourselves with the belief, that the good which our School of Arts has done, has not been confined to Edinburgh alone, but that its example has had some degree of influence in directing the public attention to a most valuable accession to those public seminaries, which, by reducing the expense of education, are calculated to bring forth genius from every rank of the people; and which add so much to the glory and power of this favoured land. These different establishments have adopted various plans; and as we are anxious to improve, as much as possible, the institution committed to our charge, we have been led to consider these different plans, as far as they have come to our knowledge. The result of that examination has been, that with the most earnest wish to avoid any undue bias in our own favour, we do not think it necessary to recommend to the General Meeting any alteration in the constitution of our establishment.

The School of Arts was founded for the purpose of giving instruction to operative Mechanics, in such branches of physical science as are of practical application in their several trades; to give them an opportunity of obtaining that systematic education *in the principles of their business, without which, in the* higher professions, no man can rise to eminence, or obtain a higher reputation than the notoriety of an empiric. If such is the object in view, the first step to be taken is, to ascertain what is the amount of time which the persons to be instructed can devote to this improvement of their education. This can only be done by examining, in detail, the occupation of a workman's day; for this self-education will not begin until he is arrived at an age when he is already engaged in his business.

He must be in his work-shop from six in the morning to seven o'clock in the evening, on an average, with the exception of the time for his meals. As he must go home to take some refreshment after work, and, judging from our experience, will generally be inclined to put off his working dress, he cannot conveniently reach the lecture-room sooner than half-past eight o'clock; and the time of assembling must be suited to those who come from a distance. No Lecture can be less than an hour long, so that it will be nearly ten o'clock before he can reach home; and he will then be fully prepared for rest. Thus it is evident, that supposing a workman to devote the whole of his leisure time to this object, an hour and a half in the day is the utmost he has at his disposal. Having ascertained the time the workman can give, the next point is to inquire how it can be most profitably employed.

There are no branches of science which can be of such general application in the Mechanical Arts, as the principles of Mechanical Philosophy and Chemistry; and we are fully persuaded, from the experience of the three last years, that to convey any solid instruction in these branches, such as the workman may turn to practical account, requires all the time he has to bestow. It would be very easy to introduce many parts of science which would attract by striking phenomena, and, by contributing to their amusement, would draw together a very crowded audience; but this could not be done without sacrificing objects of far higher value. We have found that, to teach the elements of Chemistry, and show their application in different Arts, requires, at the least, thirty Lectures; and as not more than one day in the week can be allotted to that subject, these constitute a course of Lectures of seven months duration. The same number of Lectures have been found scarcely sufficient for a

very limited course of instruction in the principles of Mechanical Philosophy, as connected with the Arts, and more than one day of the week could not be devoted to this branch. For, to derive any benefit from such Lectures, or to be able to understand the practical books on the various subjects of Mechanics, a knowledge of the higher branches of Arithmetic, and of the elements of Algebra and Geometry, is indispensable. The Mathematical Lectures have consequently occupied a great portion of our time; two days a-week for the students of the first year, and one day for those who were in some degree advanced, by the instruction of the preceding year. Moreover, as Lectures can be attended with comparatively little advantage, unless the subject is studied in books, the student must set aside a portion of his time for reading at home. It is therefore quite evident that, to teach the elements of Chemistry and Mechanical Philosophy, every hour of the week which we have at our disposal is occupied. It may be said, that those who have already acquired a knowledge of the principles of Chemistry and Mechanical Philosophy, may enter upon other subjects of science: they certainly may; but if they do so, another institution must be created; for, were there no other obstacles, want of time alone renders the two objects manifestly incompatible. If solid instruction is the object of institutions of this nature, the attention of the student must not be distracted by too great variety—in the one case they must produce incalculable benefit; in the other, the good they do will not be unmixed with evil; for a smattering of science too generally engenders conceit, and confirms ignorance.

We are of opinion that the same rule applies in the selection of the books for the Libraries of these institutions; and we have adhered strictly to the exclusion of all works that do not relate to science and art, having declined several donations of books, because they were not connected with the purpose for which the School of Arts was founded.

Within the last few days, a circumstance has come to our knowledge, which it is very gratifying to us to be enabled to state to the Subscribers. We were informed that one of our pupils had obtained a very advantageous situation in the establishment of Messrs. Girdwood and Company of Glasgow, one of the most extensive manufactories of Steam-Engines and other Machinery in the kingdom, and that he was mainly indebted for that appointment to his acquirements in the School of Arts. As so important an evidence of the practical utility of the institution might be of great use in stimulating the Mechanics of Edinburgh to avail themselves of the improved education now within their reach, we applied to Mr. Girdwood to know whether our information was correct, and that gentleman returned for answer, that "John Cameron, in applying to Claud Girdwood and Company for the situation of Junior Clerk, which they had to fill up, was selected from amongst 30 to 40 applicants, as being better recommended generally, *and in particular, for his scientific attainments.*" This young man, a joiner by trade, was one of the most regular and diligent students during the last two years, and was one of the most distinguished in the Mathematical Class.

The course of Lectures on Chemistry delivered last session by Dr. Fyfe, was very similar to that of the two preceding years, a syllabus of which is annexed to the First Report of the Directors. The chief new matter which he introduced was on the subject of Gas Light, when he entered into considerable detail on the properties of Coal and Oil Gas. If time will permit, the Directors propose to introduce next year, in addition to the regular course on the Elements of Chemistry, some extra Lectures on the Chemical Arts, so as to enable the Lecturer to enter with more minuteness into the processes, than is practicable in the general course. The arts that will probably be treated of in this manner during the next session will be Dyeing, Tanning, Bleaching, Brewing and Distillation, the Construction of Fire-Places and Furnaces, with the management and economy of Fuel.—(*To be continued.*)

MISCELLANIES.

Description of Vettie's Giel.

(Concluded from page 461.)

Above Vettie farm, the goodman told me, it was more narrow, more difficult, and more frightful, than the part of it which I had seen. He and his people had often to go up that way for small timber, and other things necessary on the farm.

On the sides of it, too, were the finest valley and mountain pastures, of the greatest value to their rearing of cattle. Their corn was sometimes destroyed in harvest by frost. For more than half the year, the two families living on this farm, the farmer himself, and his houseman, are cut off from all other human intercourse. In winter, the ordinary path is impassible from snow and ice, and especially from those frequent columns which leave traces of themselves a long way on in the summer, because the sun's rays, resting but a short time over this long, monstrous gulf, it is seldom before the month of July that this ice is all away. For a short time in winter, when the river Utledal is frozen, there may be a passage along the bottom of the Giel, but not without danger from the avalanches, which, with tremendous violence, tumble down into the deep; the very air of which overthrows every thing. In the end of harvest and the spring, all approach to and from Vettie is barred; in the end of harvest particularly, from the falling of earth and stones, which are then loosened by the frequent rains.

At a little distance behind the dwelling-house of Vettie, in the back-ground of the dale, there rises up a large mountain precipice, over which, where a new Giel begins, there rushes the highest waterfall I had yet seen, called Markéfoss. High falls, indeed, are here so common, that they at least excite less attention, especially where the mass of water is not very considerable; but what seemed to me exceedingly singular in this one, was, that the fall is so perfectly perpendicular, that not one drop of its water touches the whole side of the mountain. From the gap through which it issues, the mountain bends inward like the side of an arch, in such a manner, that if the place were accessible ,one might make a passage between the mountain and the fall. As the mass of water here meets with no resistance, it makes no alarming noise; I only heard its distant sound in the bottom of the Giel, which it was impossible for me to see, as all view and all approach is barred by high sharp-pointed rocks, and a chaotic assemblage of large blocks of granite. Over this precipice lie the pasture-grounds of Vettie, where are some of the finest sketches of wood to be found perhaps in the *whole* province. *Here grow the finest* trees for masts, of uncommon height and thickness, unused and incapable of being used, because they cannot be got down through the Foss, without being splintered into a thousand pieces. It is difficult to get even common house timber this way, for perhaps not one out of ten pieces remain of sufficient length. In former times, this wood was the property of the Copperwork Company of Aardal, which had its best supply of charcoal from it. It was the more valuable to them, that its situation excluded it from every other use. I saw a man going up the precipice which leads to this wood. At the distance at which I stood, he seemed like an insect creeping up a wall. By frequent turnings from one hand to another, it is rendered possible to go up a path, from which, however, nothing is more easy than to break a neck. But born and brought up as the people are here, amidst such dangers, they disregard or are not sensible of them. The boy, the youth, grows up amidst venturous feats, and courage is his life's constant guide. Of the mountain summits here, I mention only Fleskeunasstiud, because it is considered as the highest next to the summits of the Young Harlots.

I spent the night at Vettie, and was next morning out with the goodman to have a full view of his little romantic dale, where hill and valley, wood and water, the lofty black mountain-masses, over which the majestic fall poured its foaming silver, were all grouped in the most picturesque manner, in a landscape in which the strongest features of Nature were wonderfully blended with her sweetest smiles. The severe and the gay moderated one another by being mingled in one look. The chorus of the feathered tribe only was wanting in wood and forest. The temperature here is too severe for the delicate songsters of the sky; nowhere does the lark mount in his airy flight; even the thrush flies to milder regions. The cuckoo only, with his monotonous song, for a short time enlivens the silence of the wood.

I had learned from the goodwife how they carry their children from this place to church. I was curious to learn of her husband, how they got the dead carried from it to the church-yard. It is impossible that two people could go beside one another in the Giel; and I could not conceive that a coffin could be placed on horse-back. He gave me the

following account: The dead body, wrapped in linen, is laid on a plank, in which are bored holes at both ends, to which are fastened handles of cord. To this plank the body is lashed, and is thus carried by two men, one before and another behind, through the Giel, till they come to the farm-house of Selde, where it is laid in a coffin, and carried in the common way to the church-yard. If any one die in winter, at a time when the bottom of the Giel is not passable, or in the spring or harvest, they endeavour to preserve the body in a frozen state, which is seldom difficult, till it can be carried off in the manner I have just mentioned. Still more singular was the method which the goodman told me was employed several years ago, to convey a dead body to the grave, from a houseman's place in Vormelien. This place lies in Utledale, which borders with the fields of Vettie. It has a most frightful situation, deep in the Giel, by the side of the river; and, like Vettie, has no other road but a small steep path, on the side of the most dreadful precipices. As the inhabitants of this place has been often changed, there had been no deaths here. It happened, at last, for the first time, that a young man of seventeen years of age died. It never occurred to them to think how they should get him carried to the grave, and a coffin is prepared for him in the house. The body is laid in it and carried out; and now, for the first time, they perceive, with amazement, that it is impossible in this way to get on with it. What is to be done? Good counsel is here precious. They leave the coffin as a *memento mori* at home, and set the dead body astride on a horse; the legs are tied under the horse's belly,—a bag of hay is well fastened on the horse's shoulders, to which the body leans forward, and is made fast; and in this manner rode the dead man over the mountains, to his resting place in Forthuus Church in Lyster,—a fearful horseman.

After a long and fatiguing weary walk, I returned with the goodman to his house. A rich soup, made from excellent wedder mutton, killed the night before, smoked from the white clad table. And what is not excellent when it is presented to you by hospitable hands! So long as nature and generous simplicity is preferred to art and ceremony, so long will such a patriarchal meal, to which you are invited with a welcome from the heart, and which is gratefully received, be preferred to ostentation and extravagance. They wished me much to remain another day at Vettie; but as I had fixed to go that day to Aftdal, and then over the mountains to some of the mines at Aardal Copper-works, I was obliged to bid farewell to the worthy people, whose extraordinary place of residence I had for the first, and I believe also for the last time, now seen.

With my former guides, and a man-servant from Vettie, I set out on this fearful way back. From the heavy rain, much of the ice had disappeared; and I had the dangerous pleasure of seeing one of these masses of ice tumbling down in a thousand pieces into the gulf: over two only of the most obstinate were we obliged to cut our road over the ice. In good time I reached Ielde; and here, where nobody dreamt of danger, my horse tumbled with me over the side of a little hill. Thus ended an excursion, the whole object, and the whole result of which was the view of Vettie's Giel.—*Ed. Phil. Jour.*

THE SCRAP GATHERER.

No. 24.—*Discovery of Glass.*—The art of making glass is not of very high antiquity, though it appears to have been practised among the Phœnicians some centuries before the Christian era. Pliny's account of its origin is very probable.—"That the crew of a merchant vessel, which had entered the river Belus in Syria, having gone on shore, kindled a fire on the *sand*, and supported the vessel, in which they were to cook some provisions, on blocks of *nitre*, that made part of their cargo. The fire, which gradually dissolved the nitre, and mixed it with the sand, occasioned a transparent matter to flow, which in fact was nothing less than glass."

25.—*Specific Gravity.*—Hiero, king of Syracuse, having furnished a workman with a quantity of gold for making a crown, suspected that he had been cheated, and that the workman had used a greater alloy of silver than was necessary in the manufacture of it; he therefore applied to Archimedes for a detection of the fraud. This celebrated mathematician was led by chance to a method of detecting the imposture, and

of determining precisely the quantities of gold and silver of which the crown was composed. While he was bathing in a tub of cold water, he observed that, as he immersed his body in it, the water ran out; and he immediately concluded, that, supposing the tub full, the water which ran out when his whole body was immersed, was equal in bulk to his body. Archimedes was so pleased with the discovery, as to run about the streets exclaiming, "I have found it!" The principle having thus suggested itself to Archimedes, he procured a ball of gold and another of silver, exactly of the same weight as the crown—considering that if the crown were altogether either of gold or silver, the balls of gold or silver would be of the same bulk, and consequently, when immersed in water, would raise it just as high as the crown would if immersed. And if, on the contrary, the crown was of gold and silver, mixed in a certain proportion, this proportion would be discovered by height to which the crown would raise the water, higher than the gold ball, or lower than the silver ball.

26.—*Fahrenheit's Thermometer.*—This great improver of the thermometer was originally a merchant of Dantzic, who, having failed in business, and being attached to chemical and mechanical pursuits, was obliged to gain a livelihood by making and selling these instruments. The division of the thermometric scale, had occupied the attention of several learned and ingenious men; but it was Fahrenheit who first pointed out the most accurate means of accomplishing this purpose. He observed how the boiling point differed under different degrees of atmospheric pressure, and pointed out the necessity of fixing it at a mean barometrical altitude. He had also noticed, that a degree of cold, much more intense than that of ice, might be procured by a mixture of snow and salt; and conceiving this to be extreme cold, he commenced his scale from that point, which is 32° below the freezing of water. Accordingly, Fahrenheit's scale commences 0°, the temperature of his freezing mixture; the freezing point of water is marked 32°, and the boiling point 212°; the space between the freezing and boiling of water being divided into 180°.

27.—*Power of Machinery.*—Mr. Owen calculates that two hundred arms, with machines, now manufacture as much cotton as twenty millions of arms were able to manufacture without machines forty years ago; and that the cotton now manufactured in the course of one year in Great Britain, would require, without machines, sixteen millions of workmen with simple wheels. He calculates farther, that the quantity of manufactures of all sorts, at present produced by British workmen with the aid of machines, is so great, that it would require, without the assistance of machinery, the labour of four hundred millions of workmen!

28.—*Progress of a Pound of Cotton.*—The following history of a pound weight of manufactured cotton, will show the importance of the trade to the country in a very conspicuous manner:—The wool came from the East Indies to London; from London it went to Lancashire, where it was manufactured into yarn; from Manchester it was sent to Paisley, where it was woven; it was next sent to Ayrshire, where it was tamboured; afterwards it was conveyed to Dumbarton, where it was hand-sewed, and again returned to Paisley, when it was sent to a distant part of the county of Renfrew to be bleached, and was returned to Paisley, whence it was sent to Glasgow and was finished; and from Glasgow was sent by coach to London. It is difficult to ascertain precisely the time taken to bring this article to market; but it may be pretty near the truth to reckon it three years, from the time it was packed in India, till in cloth it arrived at the merchant's warehouse in London, whither it must have been conveyed 5,000 miles by sea, and 920 by land, and contributed to reward no less than 150 people, whose services were necessary in the carriage and manufacture of this small quantity of cotton, and by which the value has been advanced 2,000 per cent.

29.—*Changes of the Kaleidoscope.*—The following curious calculation has been made of the number of changes this wonderful instrument will admit. Supposing the instrument to contain 20 small pieces of glass, &c., and that you make 10 changes in each minute, it will take the inconceivable space of 462,880, 899,576 years, and 360 days, to go through the immense variety of changes it is capable of producing; amounting (according to our frail idea of the nature of things) to an eternity. Or, if you take only 12 small pieces, and make 10 changes in each minute, it will then

This sham modesty, however, will not suit his purpose, as it is evidently got up with the intention of irritating our honest neighbours, after having done all in his power to do the same by our correspondents. This is another proof of its being of Glasgow manufacture. Not satisfied, even with this, he proceeds, in the worst spirit of honesty, to quote a passage from the first number of our work, and to give it a misconstruction which would never have entered into any person's brain but that of a violent partizan seeking occasion to depreciate a useful work in the eyes of a whole nation. He has, however, completely missed his mark, and we wonder extremely that the *learned editors* of the London Mechanics' Magazine did not detect the egregious blunder he has committed. The article in question is entitled " Scotch and English," and was merely put in to fill up a corner, at the end of the first number. This writer, evidently with a sinister design, has, unfortunately for his cause, quoted this passage as if it was written by us, whereas it contains the *concessions of the English themselves*, and was actually taken from a London Magazine entitled the " Literary Examiner," p. 239, published so far back as Oct. 11, 1823, nearly three months before the first number of our work made its appearance. How, now, must the writer of such an article feel, after having thus exposed his ignorance? Where is the use, now, of all his fine remarks about " Mr. Christopher North and *Balaam?*" Where does the " boasting adulation" lie now? What, in all the world, has such a sentence, taken from such a work, and written by such an author as H———, to do with the " exaggerated notions," the " odious comparisons," and the " taunts and sneers," which this humbug writer talks of? Has it any connection with mechanics? None at all. He is just as far mistaken, in his application of the passage, as Don Quixote was when he took the flock of sheep for an army of giants. Had the conductors of the London Magazine known how to be just, (as for generosity we did not expect it,) they would never have allowed such a violent tirade to be inserted in their columns. With respect to " the *new facts* furnished by this (the Glasgow) Magazine," we doubt not but they are as numerous, if not more so, than those which appear in the columns of its cotemporary; and as to its assuming a " preceptorial character," if it be properly sustained, this ought to have been reckoned one of its excellencies instead of one of its defects. That this forms no part of the London Magazine's character, must necessarily be inferred from the contempt it endeavours to throw upon ours. That more *new facts* might have been expected from this " seat of so many arts and manufactures," we do not deny, but that it is not our fault that they are not published, we beg leave to state, not for the satisfaction of this hypercritic, but that those who withheld them, when application was made on our behalf, may read this and take shame unto themselves for their refusal, and that they and others who are in possession of *new facts* and *new machinery* may be led to transmit accounts of the one and descriptions of the other, for the instruction and advancement of the community, in the useful arts. This writer in conclusion, alludes to one and only one of our best articles, though he is perfectly aware that there are many which are superior to any that ever appeared in the London Magazine, and proceeds to quote two or three articles, which, though useful, are of minor merit and importance, under the pretence that they are " of more convenient length for quotation." We might, if we were disposed to produce an unfavourable impression against our cotemporary, quote some articles from its columns of less interest even than these, but having extended our remarks to a considerable length already, we do not choose to fill our columns with useless articles, even from the pages of a journal which calls itself a *parent*, though it can only boast of four month's previous existence to our own.

Notice to Patentees, Inventors, &c.—Patentees, Inventors, and others, in London, Edinburgh, or Glasgow, who wish to have their Patents, Inventions, and Communications, inserted in this Magazine, are respectfully requested to transmit them (post paid) to the Publishers in these respective places, and they may rely on the most prompt attention being paid to them.

Notices to Correspondents must be deferred till next week.

ERRATUM.

In some copies, in the article on Mr. Gibson's Elastic Hats, p. 439, col. 1, line 25, for *pasteboard*, read *felt*.

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J. CURLL, PRINTER.

THE GLASGOW MECHANICS' MAGAZINE.

"O Music, sphere-descended maid,
Friend of pleasure, wisdom's aid!
Where is thy native simple heart,
Devote to virtue, fancy, art?
Arise, as in that elder time,
Warm, energic, chaste, sublime."—*Collins.*

No. XXXI. *Saturday*, 31*st July*, 1824. Price 3*d*.

A NEW MUSICAL INSTRUMENT,

Called by Friend Hatton, the Inventor, a Chamber Flute-orum, for Sacred Music, or Slow Songs.

—Swan Sc.—

A NEW MUSICAL INSTRUMENT,

Called by Friend Hatton, the Inventor, a Chamber Flute-orum, for Sacred Music, or Slow Songs.

Respected Friend,——About twenty years ago, *love* and music had much more impression on me than they can possibly have now, when forty revolving years cry aloud, in the language of the soundest philosophy, "that life's meridian is already past;" I say, twenty years ago, when traversing the fields, with my flute, one blowy summer's evening, I accidentally turned the mouth-hole to the wind, I raised my fingers, and the wild tones came forth like the sound of the Æolian harp. Transported with the discovery, I thought, if the rude blast of the field can produce this effect, surely something may be invented to blow, and then I shall be enabled to accompany it with the voice. This idea laid the foundation (I may freely aver) for ten thousand experiments, and it is only about twelve months since I was convinced that I could make no farther improvements. The instrument pleases me well, and has met with the approbation of many hundreds of visitors. It has two German flutes; the one sounds the key note of the tune, and the other plays the female octave; they are blown with bellows, as represented in the plate. When accompanied with the voice, they produce melody and a kind of harmony that yields general satisfaction. Perhaps some of thy Theological readers may infer, that as I profess to be a Quaker, a departure from the ancient ritual has actually taken place with the followers of the venerable William Penn, (for the old light Friends, it is well known, condemn every kind of music both sacred and profane.) I consider myself as doing no more than justice to that respectable body of Christians, when I inform thy numerous readers that I never had, nor yet have, any connection with the Society of Friends, and I do, and will, bear testimony that, in this town, that part of the community commonly called Quakers, strictly walk in the footsteps of George Fox; except that one or two of them occasionally wear pantaloons, which may be considered as a falling off by some rigid critics. I profess to be a *new light* Quaker, and like other polemics, have hammered out a string of sentiments for myself, but as thy pages are no vehicle for such, I forbear to mention them.

I am busy, at present, making experiments on the celebrated ancient Water Clock—a mixture of castor oil and spirit of turpentine I find to be the liquid best calculated for the purpose. I have likewise altered its mode of movement from the plan of antiquity—I call it *Pousie Nanney's* Clock; for, although it should go a few minutes wrong in 24 hours, beggars are not like day's dargmen, compelled to commence labour exactly to a minute: besides, at a *splore*, or when a *row* takes place, it can suffer little injury, having neither wheel, pinion, nor pendulum, and being hermetically sealed, the dust from the mealy bags can do it no harm.

The other three articles mentioned in my former letter, and *Pousie Nanney* likewise, shall all be described in due time.

Meantime, friend, I bid thee
Farewell.

David Hatton.

Dunfermline, 25th day of sixth month, 1824.

Explanation of the Engraving.

No. 1, is a German flute, of the ordinary size, which plays the tune,

the fingers operating in the ordinary way. No. 2, is a large C flute, which sounds the key note of the tune, the tone being altered with corks which fit the finger holes, and the mouth hole of it is shut and opened by a lever valve moved by the thumb of the left hand. No. 3, the bellows that fills No. 4, which is an air cistern, the air being pressed up the two air pipes by the pressure of the left arm. No. 5, is a chest for holding music books. No. 6, is a table for the book. No. 7, is the lap frame upon which the whole apparatus is erected.

ON A SCALE OF THE PLEASURES AND PAINS OF LIFE.

A SCALE of Pleasure and Pain may be made as in a thermometer, the point 0 marking the limit of pleasure and the beginning of pain. From 0 upwards, a certain space may be marked for what may be called ease simply, and as many degrees below for uneasiness; beyond those points, pleasure or pain, properly so called, may commence. Of the many persons in the state marked uneasiness, few choose to renounce life; whence it may be inferred that, in the unhappy state, there is still some portion of ease, and the ordinary situation of life is confined to ease mixed with a portion of uneasiness, great pleasures and great pains being rare. The state of ease being habitual, pleasure of equal intensity with pain will appear less lively, and equal moments of each will appear unequal in duration. For we call every thing pleasure which exceeds our habitual state, and pain, where this habitual state loses somewhat of its intensity. Let the ordinary intensity be estimated at 10°, and let fifty degrees of pleasure and pain be alternately possessed. The absolute intensity of the pleasure will, from the habitual state having been 10°, be estimated only at 40; but to the fifty degrees of pain must be added the 10° of habitual pleasure now lost, and the state of pain will appear to be at 60°. Thus, *intensities really equal* will *be to each other : : 2 : 3, and whilst* the pleasure appears to last only two hours, the pain will seem to have been suffered three hours.

Pleasure is evidently made for us, and we for pleasure; when not carried to an unnatural excess, so far from shortening, it lengthens life; it increases the force of both body and spirit. On the contrary, pain does not sympathise with our constitution, but undermines and destroys it. Hence we might presume, that the author of our nature had scattered more of pleasure than of pain over the walk of life; and the least inquiry into the state of men will prove, that this is really the case. For the greater part of mankind is in the state of habitual ease, which consists,

1. In the agreeable sensation of simple existence.

2. In the enjoyment of health, which, if not perfectly good, is in general, to the decline of life, tolerably good.

3. In a daily succession of action and repose bringing an agreeable variety of sensations, sometimes animated, sometimes tranquil, without any mixture of mental or bodily pain.

4. The comfort attending the daily satisfying of many of our natural wants, which some may be inclined to place very high in the scale of pleasure.

5. In curiosity, an inexhaustible fund of little enjoyments.

6. In the interest which we have

in the variety of scenes daily unfolded on the theatre of the universe.

7. In the enjoyment of society and friendship, and in the memory and recital of past pleasures and pains.

8. In the satisfaction of instructing and being instructed.

9. In the variety of occupations and amusements proper to exercise the force of body or mind, in difficulties conquered, duties satisfied, and a thousand agreeable sensations of all sorts, in a mind habitually inclined to seek and enjoy the best side of every thing.

10. In hope anticipating the enjoyment of good, whose possibility is seized by the imagination.

To this enumeration of the advantages of life, it may be objected that if the preponderance is so great in favour of pleasure, it is extraordinary that no one is willing to renew the career of life. To this we answer, that the same tune, perpetually repeated, will lose its charms; that we are made too to be continually advancing, and that, in beginning the race anew, not only curiosity and hope would be lost, but our previous knowledge would be of no advantage to us, and at the end we should only be in the same place from whence we set out. But could the offer be made to a being of the continuance of life with a succession of new ideas, though the pleasure were greatly diminished, not only the greater part of mankind would accept the terms with joy, but most of our pretended philosophers, who, confining their views to this life, have not, while they complain of it, the courage to put an end to their existence, would be found among the number.—M. D. B.

MECHANICAL INVENTIONS AND USEFUL PROCESSES.

ON THE CONSTRUCTION OF HOSPITALS.—By Mr. Le Roy, Member of the Royal Academy of Sciences.

The construction of hospitals is in general objectionable, either because many of the wards do not admit of perfect ventilation, or because the air passes from one patient over another, by which means contagious diseases are often spread.

To avoid these inconveniences, a large hospital should consist of distinct and separate buildings, each forming one ward, erected upon arches or columns, at a considerable height from the ground, and ranged at a distance from each other, like the tents of an encampment.

The ceiling or roof of each ward should be formed into a number of spherical arches, according to its size, the crown of each arch being in the middle of the breadth of the ward, and opening into a funnel like a common chimney, *which should be supplied* with a vane, *(resembling that we call a cowl,)* so that *it may always open to leeward.*

In each floor, mid-way as to breadth, should be a row of holes at suitable distances from each other, to admit air from below, so constructed that the quantity of it may be regulated at pleasure.

In consequence of this structure, there must be a constant change of air; for that which is in the lower part of the ward, being warmed by the patients and nurses, and the necessary fires, will ascend, and in consequence of the spherical construction of the roof, will be directed to the openings in it, and flow through them, while the holes in the floor will afford a constant supply of fresh air, which will move rapidly, as it enters the room so low.

A number of arches, with openings, is preferable to a single arch in the centre, because the air, in passing from the extremities of the room to the centre, flows from one patient over another—and a plane, or flat ceiling, even with apertures, is improper, because the upper air, at a distance from the apertures, cannot move to them.

The rooms may be warmed by placing grates, or stoves, over these holes in the floor, and no bad effect can be produced by the fire, as the air and vapours will ascend from it, and go off by the holes in the ceiling. If it be necessary to quicken the circulation of air, either on account of the sluggishness of the atmosphere, or of the contagious nature of any diseases in the ward, small fires may be fixed in grates or stoves near the openings in the ceiling, to increase the motion of the air.

To prevent the spreading of contagion, as well as to keep the sick from beholding the sufferings of each other, a screen of suitable height should be placed between each bed.

For contagious disorders and surgical cases, there should be a number of wards, at a distance from the hospital, and to leeward of it with respect to the prevailing winds.

AN EASY AND EXPEDITIOUS METHOD OF DISSIPATING THE NOXIOUS VAPOUR COMMONLY FOUND IN WELLS AND OTHER SUBTERRANEOUS PLACES.

AFTER various unsuccessful trials, I was led to consider how I could convey a large quantity of fresh air from the top to the bottom of the well; supposing that the foul would necessarily give way to the pure. With this view I procured a pair of smiths' bellows, fixed in a wooden frame, so as to work in the same manner as at the forge. This apparatus being placed at the edge of the well; one end of a leathern tube (the hose of a fire engine,) was closely adapted to the nose of the bellows, and the other end was thrown into the well, reaching within one foot of the bottom. At this time the well was so infected, that a candle would not burn at a short distance from the top; but after blowing with my bellows only half an hour, the candle burned bright at the bottom; then, without further difficulty, I proceeded in the work, and finished the purification of my well.

Wells are often made in a very slight manner, owing to the difficulty of working in them, and there have been several fatal instances of the danger attending the workmen; but by the above method, there is neither difficulty nor danger in completing the work, with the utmost solidity.

It is obvious, that in cleansing vaults, and working in any other subterraneous place, subject to damps, as they are called, the same method must be attended with the same beneficial effect.—E. R.

A METHOD OF DRAINING PONDS IN LEVEL GROUNDS.

AT a certain distance below the surface of the earth, there is a stratum of loose sand, which freely admits the passage of water. This stratum is at various depths, in different elevations; but it will be generally found, that lands most subject to stagnant ponds, have but a shallow stratum of clay, over the sand.

All that is necessary, therefore, is to dig a pit in the bottom of the pond, till you arrive at this stratum of sand, when the water will be immediately absorbed, and the pond emptied. Should there be too much water to permit a hole to be dug within the pond, it may be made at the edge of it, the communication afterwards made by a trench. It would be prudent not to make the sides of the pit so steep, as to prevent cattle from getting out, should they happen to go in.

The idea of the plan was suggested by seeing it practised by a farmer, who enjoyed the benefit, though he did not appear to know the cause.—J. H.

DESCRIPTION OF A MACHINE FOR MEASURING A SHIP'S WAY.

CLOSE along the ship's bow, is a copper pipe, about two inches in diameter, extending downward as low as the keel, and upward above the water-line when the vessel is loaded. This pipe must be so bent at the bottom as that its orifice may be directly opposed to the line of the ship's progress, and project but a little way beyond the keel or cut-water. The upper part of this pipe must also be so bent as that it may enter into the fore-castle, through a hole made for the purpose, above the water-line. The pipe should be secured in its place by staples or clamps.

On the top of this copper pipe should be a cover to be screwed on, and through the cover a hole must be made for the admission of a glass tube, of the size of a common barometer tube, and cemented there. The sea water will rise in the copper pipe to the general level of the

sea, but will not appear in the glass tube because the copper pipe enters the ship above the water-line, as before observed. But if a quantity of oil be poured down the glass tube, the surface of the oil will rise and become visible in the tube, on account of the specific difference between oil and sea water.

This glass tube must also be furnished with a scale for measuring the different heights of the oil, the cypher, or (0) of the scale being on a line with the surface of the oil when the ship is at rest, or makes no way. But when she is in a progressive motion, the water contained in the copper tube, together with the column of oil in the glass tube, will be forced upward, in proportion to the velocity with which the vessel proceeds; which will be ascertained by the different altitudes of the surface of oil, visible on the graduated scale.

The glass tube should be made to run some depth into the copper pipe, and also be of a sufficient height above, to allow room for the vibrations of the column of oil, when the ship is agitated by the waves.

When the ship has got every thing on board, and whilst she is under no way, the surface of the oil must be regulated by bringing it even with the (0) or cypher of the scale; and this examination should be frequently made on account of the consumption of provisions, and other waste, that may alter the ship's draught of water.

In taking down the reckoning from the scale, the most favourable moment should be watched for a fair observation, *viz.* when the ship is proceeding with an average velocity, not when she is in the act of plunging into, or rising above the level of the waves, as this would sensibly affect the truth of the scale. But a little experience would soon make the use of the instrument familiar.—F. H.

REMARKS ON THE ARTIFICIAL HORIZONS, &c.

The utility of a perfect horizon, and the liableness of quicksilver to be disturbed by the least wind, have induced numbers of people to invent artificial horizons of different kinds, and many of them very complicated. Some time ago, having occasion to determine the situation of several places by astronomical observations, and there being no astronomical quadrant belonging to the company in the settlement, I was under a necessity of determining the latitudes by a sextant; and that at a time when the sun passed so near the zenith as to make it impossible to get meridian altitudes; I therefore collected all the different artificial horizons, and glass roofs, and other contrivances for that purpose I could meet with; but, though they appear correct, the results were very erroneous. I examined them by bringing the two limbs of the sun, seen by direct vision, to touch apparently in the telescope of a sextant, and then observed the reflected images in quicksilver, which still appeared to touch as before; but, on examining the reflected images in the rest of the artificial horizons, none of them appeared to touch; and the error in many was very considerable. I tried a number of other methods with little success; as they were, mostly, combinations of glasses: at last, accidentally hearing some officers speaking of "tents that would neither turn sun nor rain," I considered that the rays of the sun would pass through cloth unrefracted, and in consequence of this idea I applied some thin mosquita* curtain as a covering to the quicksilver, and found it effectually excluded the wind and admitted the sun; and, what is of equal consequence in this country, it totally kept away those minute insects that disturb the surface of the quicksilver in observing; in short, it formed so complete a horizon, that I could not before have hoped for any thing so perfect; and it is equally applicable to the sun and stars.

For taking very great or very small elevations of the sun, (which, with the common horizon sextants, are impracticable in the direct method,) a polished metalline instrument might be made in the form of part of a hollow obtuse cone: this might have its axis set perpendicular to the horizon at any time, *by means of screws*, in a variety of methods; and observations might be made by it with great exactness.

In finding the latitude, when meridian observations cannot be taken, either there is an opportunity of taking altitudes on both sides of the meridian, or not: when there is not, the best method is

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* A kind of silk gauze, as close as book-muslin, and perfectly transparent: it is to be stretched over a hoop which stands without touching the vessel containing the mercury.

to calculate the latitude from two altitudes and the time between, exactly by spherical trigonometry, (first correcting the declination to the beginning and end of each interval,) as the approximating methods of Dowes and others are totally insufficient: when observations can be taken both before and after noon, it is best to take a number of altitudes in both, and then make out the equal altitudes by proportion; then, having found the true time of noon by the usual method, correct the two intervals and the declination to each time, and the latitude may be found as follows:

Cos. horary angle + Cot. decl. = Cot. A ∵ Sine A + Sine Alt. + Co. Ar. Sine decl. = Cos. B A $\pm$ B = Lat. required.

As every single altitude gives an independent latitude, it is evident the latitude may be thus found to great exactness.

An instrument might easily be contrived to measure the sun's angle of position to great exactness, from whence the latitude might readily be deduced; a small addition to the common theodolite would be sufficient. The variation of the azimuth near the meridian may also be advantageously applied for the same purpose.—R. B.

EXPLOSIVE ENGINE.

An engine of a very remarkable kind is, we understand, about to be brought into public notice; which, if it answer the high expectation of its inventor, may ultimately supersede the use of the steam-engine. The patents for England and Scotland are, we believe, both completed, so that we may expect soon to hear the particular details of its construction.

At the lower end of a small cylinder is placed a minute apparatus for producing oil gas. As the gas is generated, it elevates a piston so as to admit as much atmospheric air as when combined with the oil gas would render the mixture explosive. When the piston has reached this height, the gas is exploded, and the mechanical force of the explosion is employed to drive machinery. Experiments have, we understand, been actually made with this power, which was employed to force up water to a considerable height.

Our readers will no doubt be reminded, by this brief notice, of the ingenious invention of the Rev. Mr. Cecil, by which the power is obtained by taking advantage of the vacuum created by the explosion of a mixture of hydrogen and common air. Mr. Cecil suggested, in his paper, that the expansive force of the explosion might also be employed; but his machine was not founded on this principle.—*Brewster's Journal.*

WHITE'S FLOATING BREAKWATER.

Among the practical and useful inventions of the present day, the floating breakwater of Mr. White, for which he has received a patent, promises to hold a respectable place.

This contrivance consists of a series of square frames of timber, connected by mooring chains, or cables, attached to anchors or blocks; they are disposed so as to enclose either a rectilineal or a curvilineal space for the reception of ships, which may ride there, protected from the breaking of the sea or surf.

These frames consist of logs of Quebec yellow pine, from thirty to fifty feet long, and from eighteen to twenty inches thick. The logs are bolted together so as to form a square frame, consisting of two parallel frames. The separate frames are connected by ropes or chain cables, secured to anchors or mooring blocks. The height of these frames may be increased by logs or pieces of timber on the tops of the frames, not exceeding five tiers in a vertical position, for the purpose of breaking the waves more completely in places where the water is violently agitated.

The advantages of this breakwater have been actually experienced at Deal, and certified by some respectable persons of that place.

The inventor recommends it particularly for fishing coasts, where the surge often prevents boats from putting off and landing; and also for bathing places, where it will always produce smooth water, and protect the machines.

M. BRACCONNOT'S PROCESS FOR MAKING THE SCHWEINFURT GREEN DYE.

This green dye, which has acquired great reputation, and the secret of making which was known only to a manufacturer at Schweinfurt, has been analysed by M.

H. Bracconot. He found it to consist of arsenical acid, deutoxide of hydrated copper, and acetic acid; thus approaching, in its ingredients, to Scheele's green. After much difficulty, he succeeded in finding the following method of recombining these materials:

1. Dissolve *six* parts of sulphate of copper in a small quantity of warm water.

2. Boil *eight* parts of sulphate of potash of commerce with *eight* parts of oxide of arsenic, till carbonic acid ceases to be disengaged.

3. Mix this solution, while hot and concentrated, with the former, by a little at a time, continually stirring it till the efflorescence ceases. Care must be taken not to add the second solution, *viz.* the arseniate of potash, in excess. An abundant precipitate is formed, of a dirty yellow colour.

4. Add about *three* parts of acetic acid, or such a quantity of it that there may be a slight excess of it sensible, by its odour, after the mixture. By degrees the precipitate diminishes in volume, and at the end of a few hours there is spontaneously deposited a powder of a slightly crystalline texture, and of a very beautiful green.

5. Separate the supernatant liquor, (which, by remaining too long on the colour, might deposit oxide of arsenic, which would render it pale,) and then treat the coloured deposite with a large quantity of boiling water, to remove the last portions of arsenic which are not held in combination.

Bracconnot recommends the use of an arsenite of potash, well saturated with arsenic. Part of the arsenious acid remains in the mother waters; but this may serve for the preparation of Scheele's green, which is commonly used for paper of an inferior quality. Bracconnot was of opinion, that the addition of a small quantity of Scheele's green to the mixture promoted the production of the superior colour. The colours produced by the preceding process of Bracconnot were regarded by several persons to be more lively than that of Schweinfurt.

VARIOUS COMMUNICATIONS.

ON THE TEMPERATURE OF THE ATMOSPHERE.

Mr. Editor,—If you think the following hints are deserving a place in your Magazine, their insertion may probably be of use to D. M'L. as we do not observe that any answer has yet been given to his first query in No. 9, page 143.

It is, we believe, a generally known fact, that, in every region of the globe, the farther we ascend from the surface of the earth, the air always becomes colder, and, at a certain altitude, the temperature is so low as to keep water constantly frozen; it is also found that this height is greater or less, according to the latitude. Thus, on the Andes, under the equator, Humboldt has shown it to be 13,264 feet above the level of the sea; in lat. 46° on the Alps, 8768 feet; and in Lapland, in lat. 68°, it is 3520 feet; and, if over any meridian a line be supposed to be drawn, passing through these points, an arch will be formed, called the line of congelation, or of perpetual frost.

Now, it is evident, that the summits of mountains projecting beyond this line must always be subjected to a temperature below the freezing point of water, consequently, the snow which falls upon them will remain continually in an unmelted state, until it accumulates in huge masses, which roll down the sides of the mountains, and are melted in the vallies below.

The cause of this coldness in the upper regions of the air, will be best accounted for, if caloric be considered as a subtle fluid, originally belonging to our globe, and the sun, the great store-house of light, acting merely as an agent in the production of it. We are borne out in this opinion, by the fact, that the rays proceeding directly from the sun, have not the power of eliciting heat when they pass through a transparent medium, but only when they meet with an opaque substance; hence, the light radiating from the sun, passes onward through our atmosphere without heat being produced, there not being sufficient matter to be acted upon; but when it is retarded by the opaque body of the earth, an insensible action is excited upon the particles of matter, caloric is disengaged and heats the surrounding air near the surface;

but which never rising (on account of its greater density) to any considerable height, the higher atmosphere is left at the low temperature before-mentioned. It is in this view, that Professor Leslie has been enabled to trace the gradations of cold in the higher regions of the air, and even to determine the point at which perpetual frost commences, having previously ascertained the law which connects the capacity for heat with the rarity of the air,* and by comparing the results which he has obtained with those actually ascertained by Humboldt, the difference is so trifling that they may be considered as a proof of the correctness of the theory.

TRIO.

St. Andrews, July 16, 1824.

* See Leslie's Elements of Geometry.

BARKER'S MILL.

MR. EDITOR,—It would much oblige me, and I doubt not many others, if you, or any of your intelligent Correspondents would state what is at present thought of the water machine called Barker's Mill. The Encyclopedia Brittanica (article Water-Works) gives it such a high character, and recommends its adoption so strenuously, that it seems probable the use of it would have been much more common than it is at present, if there had not been something erroneous in the statements concerning it. Euler and Desaguliers considered it attentively, and approved of it highly, as being both a simple and an economical contrivance. As the construction of it is so simple and easy, why is it not in general use, if the power equals that of the same quantity of water on a common bucket-wheel?

I am,
SIR,
Your most obedient servant,
B. V.

BOULTON'S PUMP.

MR. EDITOR,—In a Dictionary of Arts and Sciences by G. Gregory, D. D., published in 1807, there is a description of a Pump invented by Mr. Boulton, and a drawing given of it applicable to four different situations; the plate decribing it, is at page 542 of the Dictionary. As I wish a machine of this kind, can any of your numerous Correspondents inform me if this Pump has ever been put in practice, and if it answers the end described.

A CONSTANT READER.

N. B.—The description of the Pump is in page 523, as also the principle upon which it operates, referring to figure 12 on the plate.

QUERIES.

SIR,—If any of your Mathematical readers will solve the following problem, it will oblige a constant reader;—it is Ingram's 61st Miscellany.

If a heavy sphere, of which the diameter is 4 inches, be dropped into a conical glass full of water, of which the diameis 5 inches and the altitude 6 inches, how much water will run over?

A HAMILTONIAN.

Hamilton, March 23, 1824.

2. Are flowers which are kept in a bed-room hurtful to the health of the person who occupies it?—and, if so, what is the cause?—PHILOMATHES.

3. Of any cube number under a million, given the unit figure, the two figures next the left hand, and the number of places, to name its cube root instantly and without the assistance of the pen. For example: in a certain number, given the unit's figure 6, the two figures as above-mentioned 43, and the number of places 6, what is the root?—J. D. E.

4. What is the best way to remove the marks of flies out of paper that has been exposed to the sun, without injuring its colour?—S. L.

SCIENTIFIC INTELLIGENCE.

Perkins' Steam-Engine.—The *Bibliotheque Universelle* for March 1824, contains an elaborate paper on Mr Perkins' Steam-Engine, by a friend of Mr. Perkins, which was carried to Geneva, and communicated to the editors by Mr. Church, the American Consul, who had made a voyage to London for the express purpose of seeing Mr. Perkins' apparatus. This paper contains the most complete description of the above engine which has yet appeared, and it presents,

we believe, the first attempt to explain its operation on philosophical principles.

The following will give the reader an idea of the propositions maintained in it: 1. It is said, that, in the generator, or high-pressure boiler, the heat is greatest at the top, and decreases towards the bottom, against which the flame and heat of the furnace are chiefly directed; so that while the temperature of the upper parts of the boiler is at 400°, that of the lower parts next the fire may, in extreme cases, be so low as 40°. 2. Although the water exposed in this manner to the intense heat of a furnace, remains permanently cold, yet, if any crack or opening should take place in the bottom of the boiler within which the water is pressed with a force of at least 400 lb. on the inch, no water will issue at the opening. The reason assigned for this, we are unable to comprehend, or to render intelligible. 3. It is proposed "to pump back the heat" into the boiler, after it has done its office of impelling the piston in the cylinder; to pump it back into the generator, and to cause it in this way to act again and again upon the piston; so that, in this manner, the author, in the fervour of his imagination, thinks it but reasonable to expect, that an apparatus of this kind may be constructed, which, when once sufficiently heated, will continue to move for ever, and to drive machinery of itself, without any farther consumption of fuel. On looking into his description of this part of the apparatus, we find the plan consists merely in heating the water of the generator by the waste steam from the cylinder,—a plan which has been already frequently proposed, and which is indeed practised to a certain extent in every steam-engine in the kingdom.—*Jameson's Journal.*

Singular Effect of Heat on the Colours of Glass.—In a memoir on rare minerals, published in the Memoirs of the Physical Society of Geneva, tom. i. part ii. p. 471, M. Soret mentions some curious facts respecting two kinds of glass employed by MM. Dumas and Raisin of Geneva, in giving the tints to artificial topazes.

One of these glasses, or pastes, is of a bright yellow colour, similar to that of the corundum, commonly called *oriental topaz.* When this glass is reduced to small fragments, and exposed to the action of the fire, it assumes in succession the following colours, viz. bright yellow, orange yellow, *orange, orange red, violet red.*

Another paste, of an aqua-marine blue colour, or a bright blue, passes, by the application of an increasing heat, from bright blue to bright aqua-marine green, and then to yellowish green. In cooling, the glass returns to its first tint through the same tints. If the fire is pushed to red heat, the yellowish green tint becomes a bright yellow, and finally an orange yellow. This last colour is permanent in the glass after cooling. M. Soret quotes the analogous experiments of Dr. Brewster on the ruby, and those of M. Berzelius on different metallic glasses.—*Brewster's Journal.*

Mr. Barlow's Neutralizing Plate.—We are happy to learn that this eminent natural philosopher has received the highest reward, viz. that of £500, given by the Board of Longitude, for his plate for neutralizing the action of the iron of ships in producing a deviation in the compass.

The centre of a small circular iron plate is placed in the line of the attraction of the ship's iron, and at a proper distance behind and below the pivot of the compass needle, the position of this line having been ascertained previously to the ship's leaving port, an operation which will be greatly facilitated by a table for this purpose, prepared by Mr. Barlow. When this is done, the needle will remain active and vigorous in the polar regions, and will direct itself in the true magnetic meridian, in whatever part of the world the ship is placed. This effect of Mr. Barlow's invention has been experimentally established between the 61° of south latitude and the 81° of north latitude, by the accurate observations of Lieutenant Foster, and by other naval officers. There are few scientific inventions of modern times more truly beautiful in principle, and more useful in practice, than this of Mr. Barlow's.—*Ib.*

Mr. Scoresby's New Experiments on Magnetism.—Mr. Scoresby had formerly shown, that bars of steel could be rendered highly magnetic by hammering them in a vertical position, with the lower end resting upon a poker or rod of iron. This process, however, he has greatly improved by hammering the steel bars between two bars of iron. The steel bars were the eighth part of an inch in diameter.

When only one bar of iron was used, a steel wire, six inches long, lifted a nail weighing 186 grains; but when two bars of iron were used, the wire lifted 326 grains. When the new process was em-

ployed with an iron bar eight feet long, a steel wire six inches long lifted 669 grains, or four times its own weight.

Mr. Scoresby's theory of this process is, that percussion on magnetizable substances in mutual contact inclines them to an equality of condition, in the same manner as all bodies of different temperatures tend to assume the same temperature when in contact. The two great iron bars being made magnetical by position, the interposed bar of steel will therefore, when thrown into a state of vibration by percussion, receive a portion of their magnetism. In like manner a magnet, when struck in the air with a piece of flint, or upon a body of inferior magnetic quality, will have its magnetism diminished.—*Ib.*

Aurora Borealis imitated by an Electro-Magnetic Experiment.—M. le Chevalier de Nobili, of Modena, the author of this experiment, took a large metallic wire, covered with silk, and coiled it up so as to form a spiral plate, with 24 turns, the wire of one turn being always in contact with the adjacent one. When a weak electrical discharge is made to pass through this spiral plate, a light is seen to proceed from the centre of all the spires. It resembles artificial fire, and is very distinctly visible without darkening the chamber in which the experiment is made. When the wire is coiled up in a rectangular shape, a very faint light is seen. M. Nobili considers this last as the ordinary electrical light, and the first as electro-magnetic, as it is displayed only in the case when electricity exerts a magnetic influence. M. Nobili has announced a work entitled *Questions sur Magnetisme*, in which he discusses all the recent discoveries in that science. See *Bibliothèque Universelle*, Jan. 1824, p. 39.

On the Combustion of Iron by Sulphurous Vapour.—Professor Hare has observed, that if a gun barrel be heated red hot at the butt end, and a piece of sulphur thrown into it, a jet of ignited sulphurous vapour will issue from the touch-hole, when the mouth of the barrel is closed with a cork, or when it is blown into. He found that a branch of iron wire, exposed to this jet, will burn as if ignited in oxygen gas, and will fall down in the form of fused globules, in the state of proto-sulphuret. When hydrate of potash is exposed to the jet, it will fuse into a sulphuret of a fine red colour.—Dr. Hare's *Letter to Professor Silliman.*

Mountain Tallow.—*Specimens of this mineral substance were lately found in a bog* on the borders of Loch Fyne. This curious mineral was first observed by some peasants on the coast of Finland in 1736; afterwards it was found in one of the Swedish lakes. M. Herman, physician at Strasburgh, observed a similar substance in the water of a fountain near that city; and Professor Jameson met with it in this country. It has the colour and feel of tallow, and is tasteless. The following notice in regard to it was sent to us:—It melts at 118° and boils at 290°; when melted, it is transparent and colourless; on cooling, becomes opaque and white, though not so much so as at first. It is insoluble in water, but soluble in alcohol, oil of turpentine, olive oil, and naphtha, while these liquids are hot, but it is precipitated again when they cool. Its specific gravity in the natural state of it, is 0.6078; but the tallow is full of air-bubbles, and, after fusion, which disengages the air, the specific gravity is 0.983, which is rather higher than that of tallow. It does not combine with alkalies, nor form soap. Thus it differs from every class of bodies known;—from the fixed oils, in not forming soap:—from the volatile oils and bitumens, in being tasteless and destitute of smell. Its volatility and combustibility are equal to those of any volatile oil or naphtha.—*Jameson's Journal.*

Extraordinary extent of the Baize and Flannel Manufacture at Rochdale.—" In the town of Rochdale, and the adjacent villages, there are manufactured, every week, of flannels and baizes, about 20,000 pieces, of 46 yards each, making 47,840,000 yards per annum. It is supposed that 17,840,000 yards are exported; the remaining 30 millions of yards are consumed in the United Kingdom, being an average of about 1½ yards for each individual. Some good flannels are manufactured in Wales; a few coarse ones at Keswick, and some other towns and villages in the kingdom. A few are manufactured on the Continent, and works for that purpose are now erecting in America; but the whole of the flannels manufactured on the globe, besides those manufactured in Rochdale and its immediate vicinity, are not equal in quantity to those made there. The price of flannels is from 5d. to 3s. per yard; and the average may be stated at from 13d. to 14d. per yard; so that the annual value of the manufacture may be stated at about three millions Sterling. The wool costs fully one-half of the wholesale selling price; the oil, labour, and finishing, &c. constitute nearly the other half."

ABSTRACT OF THE THIRD REPORT

OF THE

Directors of the Edinburgh School of Arts, *for the Instruction of Mechanics,* 1*st June,* 1824.

(Concluded from page 16.)

Mr. Wilson's Report.

"If the Lectures on Arithmetic had any marked peculiarity, it was that of leading the student to trace every operation which he was required to perform, to some established principle. The utility of such an exercise is too obvious to require any illustration, since it is a matter of experience to all who are engaged in conducting business, that the technical rules given in the ordinary Treatises of Arithmetic for the solution of practical questions, can rarely or never be employed. It is not meant to be insinuated that the formal mode of procedure adopted in the majority of our seminaries ought to be abandoned; but it is contended that the mere circumstance of the scholar being able to follow the routine prescribed, is an attainment of comparatively little value, unless he perceives the principles on which the rules are founded. The first object, therefore, constantly kept in view throughout the course, was to place distinctly before the understanding of the student, the precise nature of the operation to be performed; and having explained the ordinary manner of procedure by a reference to these principles formerly illustrated, to leave him to the unfettered exercise of his own judgment in discovering by what path the conclusion might be more speedily attained. To render this part of the subject more interesting, recourse was had to the palpable symbols formerly procured; and both the Roman *Abacus*, and Chinese *Swanpan* were exhibited.

"After a very full explanation of the principles of Algebra—a portion of science entirely new to the great majority of the students, their attention was particularly directed to the doctrine of chances—a subject adverted to in a very cursory manner last year; and regarding which, no information is to be found in the most popular elementary treatises. The subject, however, is one of great practical importance; for without some acquaintance with the leading principles of this doctrine, the method of estimating the value of annuities for life, of calculating the premiums on insurances, &c. cannot be understood. In the investigations connected with this subject, an opportunity was afforded of demonstrating the ruinous nature of all speculations in lotteries and other games of chance, however flattering the prospect of success, and also of showing that it was only by calculations founded on the principles unfolded in this science, that Benefit and Friendly Societies can be formed on a secure and permanent basis.

"In the department of Geometry, the truths demonstrated, were illustrated by means of palpable diagrams. The text-book placed in the hands of the students, contained demonstrations of the several theorems; but these sensible representations were found to be extremely useful in conveying accurate ideas of the truths enunciated, and in impressing them more deeply on the mind.

"It is not easy to state the precise number of students who attended the Mathematical Class. Generally speaking, the attendance was somewhat less numerous than during last session, but it was much steadier. The average may be reckoned from 150 to 200.

"At the commencement of the session, an attempt was made to classify the students, by assigning particular seats to those who were desirous of directing their chief attention to Mathematical Science. This arrangement was adopted with a view to ascertain the regularity with which the Lectures were attended, and likewise on account of the great facilities which it afforded for the examination and correction of exercises. To each seat one of the students was appointed Inspector, whose duty it was to collect the exercises of that seat to which he belonged—to examine and correct them if necessary, and afterwards return them to their respective authors. The person selected to fill the office of Inspector, was he who had excelled in the performance of exercises, and who was therefore best qualified to undertake the duty. It is almost unnecessary to add, that this duty was most cheerfully performed by all the individuals so appointed, although many of them can devote but a very small portion of time to scientific pursuits.

It was left entirely to the students to

comply with this proposed arrangement, according to their own discretion; but upwards of 70 gave in their names as desirous of having seats assigned them, and the average number of exercises performed by each (exclusive of the prize exercises) was 19.

"As several individuals who attended the Mathematical Class during the former session, had again entered as students of the SCHOOL of ARTS, it was judged expedient to devote another hour a-week for their instruction. The course of Plane Geometry through which they had passed, being in several respects incomplete, it was necessary to take a short review of the principal propositions formerly demonstrated. The elements of Trigonometry, the most useful problems in Mensuration, and the nature of Logarithms, were afterwards explained. The construction of the Sliding Rule, so useful to practical Mechanics, was then shown, and a few of the students constructed Rules for themselves. A great variety of questions were proposed in the Class, so that every one became expert in the solution of the simpler problems. It was intended, at the outset, to have demonstrated the simpler properties of the Conic Sections; but as the session was so short, it was considered more expedient to confine the attention to objects of practical utility. The few weeks that remained, were therefore employed in pointing out the construction and manner of using the ordinary instruments for Land-Measuring, Surveying, Levelling, &c.; and as the institution is now provided with an excellent Theodolite, a few of the students were occasionally employed in measuring the heights and distances of several prominent objects in the neighbourhood of the city.

"The attendance at the second Class was, of course, much less numerous than at the first, with the exception of the first three or four Lectures, when, as was to be expected, many attended who were quite unable, from their want of the requisite preparatory knowledge, to derive any benefit from such prelections. The number of regular attenders fluctuated between 30 and 50.

"About two months previous to the termination of the course, a series of exercises were drawn up for each Class, and circulated among the students. To *that individual of each Class who performed the greatest number* of these exercises, a silver medal was given; and, from the specimens contained in the Appendix, the Directors will be enabled to judge of the proficiency of the students in this department of science. They will perceive that the time has not been squandered in mere recreation, but in the acquirement of substantial knowledge.

"It would be improper to conclude my Report without adverting to the meritorious conduct of the students. Their attention was often solicited to details of a very dry and uninteresting nature, but no signs of impatience were ever manifested. From all of them I have received the greatest respect; and, from several of them, expressions of kindness and gratitude, which will not soon be effaced from my memory."

There is given in the Appendix, a few of the prize questions given out by Mr. Wilson, with a selection from the solutions that were received. It has been ascertained, to the satisfaction of Mr. Wilson and the Secretary, that these solutions are, *bona fide*, the productions of the students, and that they received no assistance whatsoever, except such as they could obtain from the books in the library, explanatory of the principles upon which the questions were to be solved.

We select the following questions from this Appendix, as we are sure they must be interesting to our readers, and in the hope that it may stimulate mechanics here, to similar exertions in the acquisition of such useful knowledge.

Exercises of the First Class.

No. I.—The number of teeth in a wheel and pinion, are 260 and 45 respectively; in how many revolutions of the pinion will there be a recurrence of the same teeth?

Answer by ALEXANDER VANNET—*Age 24—attended the Third Session.*

From a consideration of the question, it is evident that $\frac{260}{45}$ will express the number of times the pinion will revolve during one revolution of the wheel, or that 260 revolutions of the pinion will correspond with 45 revolutions of the wheel. But by reducing the above fraction to its lowest terms, or dividing both numbers by 5, we shall find that 52 revolutions of the pinion, correspond with 9 of the wheel, which will be the fewest revolutions in which a recurrence of the same teeth can take place.

Note.—If the numbers (which represent the teeth in the wheel and pinion) have no common measure, or, in other words, are prime to each other, the wheel will have to revolve as many times as there are teeth in the pinion; and, in the same time, the pinion will revolve as many times as there are teeth in the wheel, before there can be a recurrence of the same teeth.

No. VII.—A person wishes to construct an orrery, to exhibit the respective revolutions of the earth and moon, supposing the former to turn on her axis 365 times, while the latter revolves 29 times. The pinion will not admit a greater number of teeth than 12; how many teeth must there be in the circumference of the wheel?

Solution by Charles Gibb, *Mill Wright —Age* 18—*attended Third Session.*

If the number of teeth in the wheel be 365, the number in the pinion must be 29.

But the fraction $\frac{29}{365}$ may be resolved into a continued fraction,

$$\cfrac{1}{12+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{2}}}}}}$$

from which we obtain the following approximations:

1st Approximation.................$\frac{1}{12}$
2d....................................$\frac{1}{13}$
3d....................................$\frac{2}{25}$
4th...................................$\frac{5}{63}$
5th...................................$\frac{12}{151}$

that is, if the pinion has 12 teeth, the wheel must have 151.

No. VIII.—A body plunged into a vessel containing 100 pints of water, loses 12 lbs. weight; how many lbs. of salt must be dissolved in it, in order that the body plunged into the salt water may lose 19 lbs. of its weight. It being supposed that 100 pints of fresh water weigh 60 lbs.—that a body plunged into a fluid loses a part of its weight equal to that of the fluid which it displaces—and also that, when the salt is dissolved, the water is not augmented in bulk.

Solution by James Hutchison—*Age* 16 —*attended Third Session—not yet gone to a Trade.*

If 60 lbs. (the weight of the 100 pints) make it lose 12 lbs. of its weight, then to find how many lbs. will make it lose 19, state 12 : 19 : : 60 : 95 = the number of lbs. in whole (salt and water). But there were 60 lbs. of water, there must therefore be 95—60, or 35 lbs. of salt.

Mr. Buchanan's Report.

"During the course of Lectures just terminated in the Mechanical Class, in addition to the subjects treated of during the preceding session; the doctrines and the great laws of Motion were also considered; the effects of uniform and accelerated Motion were explained, and applied to calculate the laws of Falling Bodies, and of Bodies descending down Inclined Planes. The same principles enabled us to calculate the descent of rivers, and the motions and discharge of water, either running in an open channel, or propelled in closed pipes by various head pressures. After considering the subject of Clock and Watch-work, and the machinery of the various escapements, and showing those models of the institution which had not been hitherto exhibited, and to which had been added that of the Hydraulic Ram, we concluded with the subject of the Steam Engine, the elementary principles of which the students had already acquired the knowledge of in the course of their studies.

"In the course of the session, several questions were proposed as exercises for the students; the answers to which were in general satisfactory, and showed a complete knowledge of the subjects treated of. To one of these questions which was originally proposed to me by a student, one answer was received from Mr. Joseph Herries, which is so satisfactory, that I have annexed a copy of it as a specimen of the progress of the students,* in the Appendix. It exhibits such a degree of knowledge on the subject of the Strength and Stress of Materials, and of the effect of oblique and of cross strains, as very few Mechanics, at least until the establishment of this Institution, could boast. It has been remarked by Professor Robison, when lamenting the ignorance of our Artists on this important branch of Mechanics—'We doubt,'

* We regret that we cannot give an idea of this question at present, without a diagram; we may, perhaps, take a future opportunity of doing so.

says he, 'very much, if one carpenter in an hundred can give a reason to convince his own mind, that a joist is stronger, when laid on its edge, than when laid on its broad side.' Certainly, when we look at this exercise, we shall be convinced that the above reflection is in a fair way of being removed from the rising generation of our Artists and Mechanics."

At the conclusion of the Lectures last year, the summer months were again occupied by the Class for Architectural and Mechanical Drawing, under the able direction of Mr. DICK, and upon the same plan as the preceding year; an account of which will be found in the Second Report of the Directors. No one can entertain a doubt of the utility of this branch of instruction to Mechanics; and we have received a very satisfactory proof of the practical good effects, even of that limited extent of teaching, which our time permits, by having been informed by a very intelligent Master Mechanic, that the value to him of one of his most able workmen had been very greatly increased, by the power he had acquired of making drawings of Machinery. There will be, during the present summer, two Classes, which will each receive twenty-four lessons of two hours; each Class consisting of thirty students, which is the greatest number that can be taught at one time.

The Subscribers must be aware how much the success of the institution depends upon the Teachers; and its continued prosperity is the surest proof of the assiduity and skill with which these Gentlemen have discharged their duties. Besides an hour in each week for seven months, occupied in delivering the Lecture, Mr. BUCHANAN and Dr. FYFE were necessarily engaged many hours a-week, in preparing their experiments; and Mr. WILSON, in addition to three Lectures a-week delivered regularly for the same period, frequently met his pupils for examination, and he corrected weekly from fifty to sixty written exercises. Those only can judge of the extent of Mr. DICK's exertions, who are aware of the labour attending a Drawing Class of thirty pupils for two hours, with all the previous preparations of copies which are required. Nothing but an ardent zeal in the promotion of this good work, could have inspired the unwearied *industry which the Teachers have shown*; and when the sum which has been divided among them is contrasted with their labour, we are confident that the Subscribers will agree with us, that these Gentlemen are by far the largest benefactors to this Institution.

Since the last Report, nearly 100 vols. have been added to the Library, which now contains 750 volumes, all relating to Science and Arts. This important part of the institution continues to be very highly valued by the students, 3670 vols. having been given out during the last year; and the Library-room was open once a-week for consulting the books that are too valuable to be lent out; and on those nights, some of the periodical scientific works were laid on the table.

The number of students who attended the Lectures during the last session, amounted to 317.

The following is a statement of the different Trades of the Students:

Joiners, Carpenters, and Cabinet-makers	91
Masons and Marble Cutters	24
Smiths, Engineers, and Iron Founders	13
Printers	8
Bookbinders and Stationers	8
Tailors	7
Mill-Wrights	6
Painters	6
Farriers	5
Plasterers	5
Shoemakers	5
Brass-Founders	5
Mathematical Instrument Makers and Opticians	5
Bakers	5
Weavers and Warpers	5
Upholsterers	5
Silver-smiths and Jewellers	4
Tin-smiths and Copper-smiths	4
Tanners, Engravers, and Coach-makers, of each three	9
Clock and Watch-makers, Architects, Hatters, Hair-dressers, Plumbers, Flax-dressers, Farmers, Brewers, two each	16
Teachers	6
Pupils of Blind Asylum	6
Shopmen and Merchants' Clerks	54
Dentist, Musical Instrument-maker, Surveyor, Dyer, Gardener, Die-cutter, Turner, and Saddler, of each one	8
No trade given	7
Total	3[illegible]

FIRST REPORT

OF THE

SCHOOL OF ARTS AT HADDINGTON.

This Institution seems to have preceded any other in the kingdom, with the exception of Glasgow.

The population of the Burgh of Haddington does not exceed 3500 inhabitants. To observe 80 individuals attending the lectures for receiving instruction in the useful arts, is a striking proof of the good sense of its artisans.

And it is pleasing to observe the fostering care and liberality of the Magistrates of the Burgh, in giving the use of the Council-room for the delivery of the lectures, and in giving pecuniary assistance from the funds of the Burgh to assist the infant Institution. These marks of public spirit, we hope, will be repaid to them by the increase of the virtue and intelligence of future generations of their townsmen.

This Institution originated in a society of 20 members, which was first formed in the month of September, 1818. Soon after, they commenced with lectures on Mechanics and Chemistry; to which were added, at the same time, lectures on Geometry. In 1822, the Magistrates voted £10 to the Institution, and the use of the Council-room. The members now amount to 80. The Library consists of about 60 volumes on science. The fees of the students assist in defraying expenses. The lectures have hitherto been gratuitous on the part of the lecturer.

The difficulties which have attended the origin and progress of the School of Arts there, have been great; these, however, have only tended to increase the ardour and assiduity of its members.

Their present number is exceedingly respectable if the population of the town and neighbourhood is considered. The obstacles, however, which impede their progress are chiefly want of funds to enlarge the chemical apparatus and increase their library.—The encouragement and support of those, therefore, is earnestly solicited, who, aware of the importance of such institutions, will delight to extend the advantages of science to those who in early life have not been favoured with similar privileges, but whose minds, if rightly directed and applied to the principles and methods of the arts in which they are engaged, would doubtless find out new contrivances to abridge or facilitate manual labour, and render the processes now in use more simple, economical, and efficient.

Such are the institutions by which we may hope to bring into scientific operation an immense number of able and skilful auxiliaries; to foster the latent energies of other Watts and other Rennies; and so to raise the character of our country to those higher distinctions in the annals of discovery and genius, as to prove more worthy the eulogium of the celebrated Curran, that "Scotland is a nation, cool and ardent, adventurous and persevering, winging her eagle flight against the blaze of every science, with an eye that never winks, and a wing that never tires."

To this Report is appended a Syllabus of the Course, which seems to be a very useful one.

Mr. James, an engineer of Birmingham, has taken out a patent for a steam carriage, for conveyance of persons or goods on highways or turnpike roads, without the aid of iron railways.

NOTICES TO CORRESPONDENTS.

M. P., N. P., Jus, and Lucius, under consideration.—The "Scrap-Gatherer" is requested to call at the Publisher's.—We would thank D. to send us the titles of his communications, for we are afraid they have fallen aside.

Philo-mechanicus, Scotus, and the Observations on the Weights and Measures' Act, are unavoidably deferred till next week.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement which is the subject of their notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom *Communications (post paid)* must be addressed; may be had also of Steuart & Panton, *Cheapside, London*; and Edward West & Co. Edinburgh.

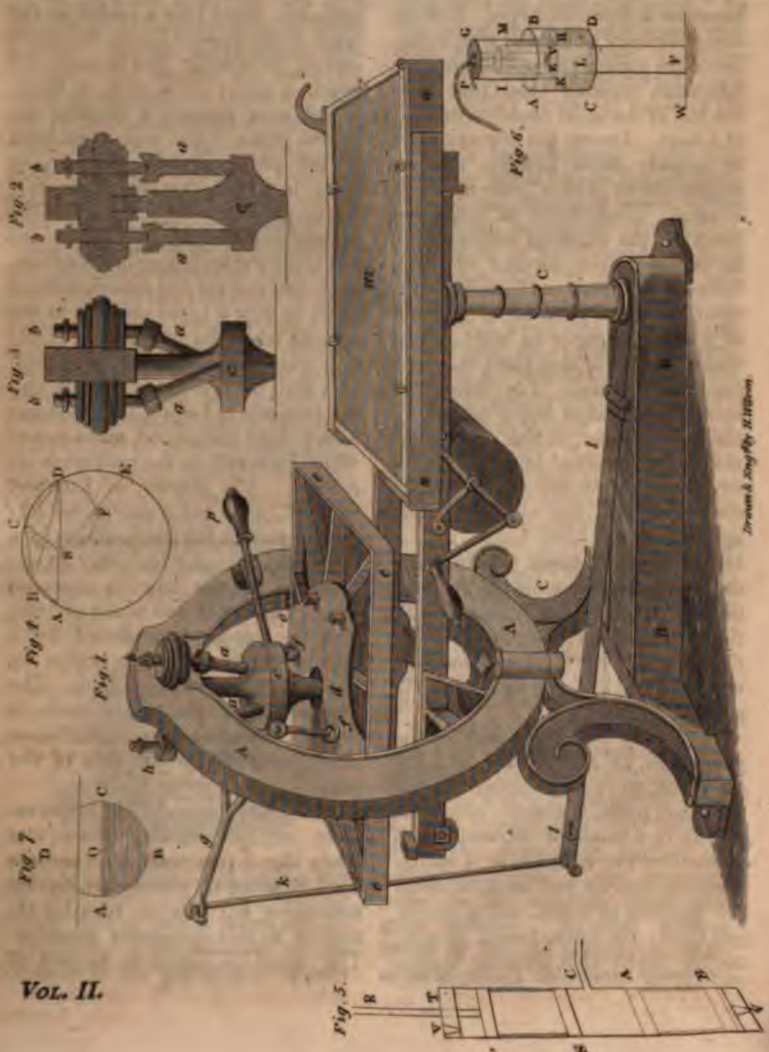
J. CURLL, PRINTER.

THE GLASGOW MECHANICS' MAGAZINE.

"Now, happier lot! enlightened realms possess
The learned labours of the immortal Press;
Nursed on whose lap the births of Science thrive,
And rising Arts the wrecks of Time survive."—*Darwin.*

No. XXXII. *Saturday, 7th August,* 1824. Price 3*d*.

AN IMPROVED PRINTING-PRESS, INVENTED BY MR. G. MEDHURST, LONDON, &c. &c.



ON THE MODERN IMPROVEMENTS IN PRINTING-PRESSES,

With a Description of a New One, invented by Mr. G. Medhurst, London.

The taste for elegant typography, and the increased demand for books of every description, which followed the rapid extension of Arts, Sciences, and Literature, throughout Europe, soon rendered an improvement on the printing-press a desideratum. It was found that the common press was deficient in the necessary power to produce a sharp and beautiful impression from the types. Besides this deficiency of power, which rendered the pressman's operations very laborious, another was, that only the half of the sheet could be printed at a time. Among the first attempts to remedy these defects, was an improvement which was made in France. It consisted of a wooden press of the common construction, having a platen formed of iron, instead of wood, and made sufficiently large to print the whole side of a sheet of paper at once. The under surface of this plate was covered with brass. The screw, or spindle, instead of being turned by the bar, or lever, in the usual manner, was connected by rods, with a strong lever, placed at the side of the press, and was worked by the application of both hands to the lever to bring it down, nearly in the same way as when working the lever of a common pump. Though additional power was thus procured, the exertion required from the pressmen was too great to bring this press into general use.

A patent was taken out in the year 1796, by Mr. Prosser, of London, for an improvement in the printing-press, which consisted chiefly in a mode of increasing the power, by the addition of a spring between the cap and head, to resist the pressure upwards, and a similar one under the lower board, or winter, to resist the pressure downwards. Another improvement adapted to the common press, was made by Mr. Roworth, a printer in London, and was found to be successful in practice. For the screw, he substituted a plain vertical spindle, furnished with a bar, hose, &c. as in the common press; but the upper part, when the thread of the screw is usually cut, was a plain cylinder, fitted into a socket in the head of the press. Upon the upper end of the spindle, just beneath the head, a short cross arm is fixed, which acts against a circular inclined plane, fixed under the head of the press. When the bar, or lever, is turned, this short arm, acting on the inclined plane, causes the spindle to descend in the same manner as the screw; but with this advantage, that the inclined plane is formed so as to give a rapid descent to the spindle when the action first begins; and when the platen comes in contact with the tympan and types, and the pressure is begun, the plane has a very slight inclination, and a power which increases as the resistance increases. Mr. Brown, of London, in 1807, took out a patent for improvements in the construction of a press, &c. part of which may be applied to presses now in common use. His press was made of iron, and the pressure produced by a screw, which was put in action by a bevel wheel and pinion. The handle which put these parts in motion, was fixed on a spindle, or shaft, attached to the side of the press.

The most successful improvement on the printing-press was made about this time by the late Earl Stanhope, whose genius for mechanics led him to turn his attention to this important machine. The Stanhope press is formed of

iron, and prints the whole side of a sheet of paper at once. The most important part of the invention consists in having obtained, by a combination of levers, the requisite degree of pressure, without the excessive labour of the common press, where the lever or bar is fixed on the axis of the screw. A short lever is applied upon the top of the screw, and is connected by a link with the extremity of another lever, which is fixed upon the top of a spindle or axis placed parallel to the screw. To the lower end of this spindle, the handle or lever for working the press is attached; and the relative position of the levers is such, that when the pressman first pulls the handle towards him, the platen is moved or brought down with a considerable velocity; but when it arrives at the position where the pressure is required, the levers have changed their position in such a manner as to operate upon the platen with a very slow motion, and a power immensely great. This principle has been employed, with certain modifications, in almost every kind of printing-press that has been brought forward since the period of Lord Stanhope's invention. The following figure of this press will aid the reader in forming an idea of it, and in comparing it with the new one represented in the engraving:

An improvement was made upon the Stanhope press by Mr. de Heine, and a patent taken out for it in 1810. The principle of this invention is the *application of two* sectors, or a sector and a cylinder, or a sector and a roller, to move against the other by a single or compound lever. The only material improvement is the substitution of a spiral or curved inclined plane, instead of the screw. In turning the lever, the piston attached to the platen is depressed, as by the common screw, but with this difference, that as the descent of the piston increases in velocity, the power increases in the same proportion. In the screw, the descent is equal, and, consequently, the power. The lever is fixed to a moveable spindle, and a regulating screw is fixed at the top.

Some improvements were also made by Mr. Keir, on the construction of the Stanhope press, which have been considered as contributing much to its accurate working and durability. A cylindrical hole is bored in the centre of the press, into which a cylinder is accurately fitted, with the platen fixed on its lower end. To prevent the cylinder from turning round, it is made with a flat side, and a bar of iron, screwed across the two cheeks, bears against this side. Another improvement consists in the spindle, to which the handle is fixed, having a screw cut upon its lower end, which is fitted into a nut, so that when it is turned round, the spindle rises and falls a space equal to that passed over by the descent of the main screw in the same time. By this means, the connecting lever always draws in a horizontal direction. In the other presses, one end remains at the level while the other descends, which occasions the joints to wear irregularly. Mr. Brooke, about the same time, applied the compound levers of the Stanhope press to the common press with great success. As the wooden frame of the old press is not sufficient to afford the same resistance

as those constructed of iron, the power of these presses is, of course, much inferior. This improvement, however, has been pretty generally adopted.

The printing-press, which forms the subject of the engraving, was invented by Mr. G. Medhurst, of London, and it excels every other improved press in the simplicity of its construction. Besides the very great merit which it possesses in this particular, and which renders it much cheaper than the Stanhope press, it has the same, if not a greater advantage in point of power than the latter. The pressure is produced by a peculiarly beautiful arrangement of levers, differing considerably from any thing hitherto employed in machinery. This circumstance has led the inventor to denominate his mechanism a new power in mechanics.

This press is similar to the common one in all its parts; but the platen is made the full size of the sheet, and, instead of a screw, a plain spindle is employed. On the lower part of the spindle a circular collar or plate is fixed, into which the bar, or lever, which forms the handle of the press, is fastened. This plate affords steps or cups for two short iron rods or pins, which extend up to the head, and are there supported by the points of two screws in the head, entering sockets cut out in the pins, which are made of steel. When the platen is up, these pins stand in an inclined position; but when the spindle is turned by the lever or handle, the circular plate in which the lower end of the pins rest turns round likewise, and, the upper end remaining stationary, they come into a vertical position. In this motion, the spindle and attached platen are forced to descend in the same manner as if a screw were employed. *To guide* the platen while in motion, a feather is made on each side of the frame, having a corresponding groove in the plate, to which the platen is attached. Fixed to this plate, and behind the frame, a vertical rod or piston is made to slide in a collar fastened to the head; and the plate itself is kept up by means of hooks and eyes fastened to the end of a lever, which extends over the back part of the platen, and is connected with a spring fixed in the sole of the frame. The motion produced by this construction seems to have every advantage of the Stanhope levers, or Mr. Roworth's press, without the friction of either; for the power increases as the resistance; and when the pins come nearly parallel to the spindle, or to a vertical position, it is immensely great. This press possesses, besides, a great advantage over the Stanhope press, in being so cheap, that it costs only about one-half of the expense.

Fig. 1 is a perspective of the press. Fig. 2, a section, showing the position of the pins when vertical. Fig. 3 shows their position when the platen is up.

aa, the steel rods or pins—*c*, the collar or plate on the spindle—*d*, the plate to which the platen is attached—*ee*, the platen—*ff*, hooks and eyes on which it is suspended—*g*, the lever for keeping up the platen—*h*, the rod connecting this lever with the spring—*ll*, the spring—*m*, the tympan—*nn*, the type carriage—*p*, the lever or handle of the press—*o*, the feather and groove. A A, the frame—C C, its supports—B B, the sole of the frame.

While on the subject of printing-presses, we must not omit the invention of our ingenious countryman, Mr. Ruthven, who in 1813 took out a patent for a press, in which the necessary power is pro-

duced by a combination of levers alone.

All the alterations or improvements hitherto mentioned, retain the original principles of placing the types on a moveable carriage, where, after being inked, they are passed under the power for producing the impression, and then returned: the reverse of this is the construction of Mr. Ruthven's; and as it is from this his decided point of excellence chiefly arises, we shall be a little particular in explaining it. When the types on the moveable carriage comes under the pressure, a horizontal and perpendicular motion is in action, which effectually prevents that necessary steadiness requisite to produce a clear impression. In Mr. R.'s presses, the types are fixed on a stationary tablet; the upper surface is brought over by the side till it connects itself at each end, with the parts under the tablet, which consist of a combination of levers and cranks, that produce an inconceivable power, and are so placed, that while the power is applied at each end, the resisting point is up against the under surface of the tablet; by this arrangement, the horizontal motion with the types is completely avoided; and as the upper surface cannot come in contact with the types till in a situation exactly over them, that point is gained which has been so long desired, of the upper surface descending steadily on the types. Another important object is also attained by Mr. R.'s presses; the power being applied at each end of the upper surface, an equality of pressure is thereby diffused not to be attained by any other press where the power is applied in the centre of the upper surface. The result arising from these combined advantages in Mr. R.'s presses, is not only a clearness of impression, that enables a general observer to distinguish *the work printed by* them, but, what we consider of at least equal importance, is a saving in the durability of the types, from the manner of producing the impression, which is now satisfactorily ascertained.

By this invention, the workmen have also been relieved from an exceedingly laborious, and even dangerous part of the profession; as the manner of exerting their strength, and the lateral action on the body, by pulling the lever in other presses, is well known to have produced fatal pulmonary complaints.

In Mr. R.'s presses, the power is applied to a lever moving in a vertical circle, which is stopt in a horizontal position under the hand, and by this means also producing a uniform impression. From the upper surface being taken down at each end, the power, of course, is alike at each end, without a bearer to support the other; in other presses, the work must not only be exactly under the centre, but must also have bearers with every work that cannot be so placed.

The principles on which Mr R.'s presses are constructed, admit of being made to various sizes, retaining all their advantages. The following statement is given of the different sizes that are at present made, with the space they occupy:

	Size of upper surface.	*Space for Press.*
Newspaper press,......	21½ by 31 inch...	54 inch. sq.
Super-royal,............	21½ by 27½ do......	44 do.
Royal, or Demy,......	19¾ by 26 do......	42 do.
Foolscap, or ½ demy,.	14 by 16¾ do......	30 do.
Royal quarto,..........	8½ by 10½ do......	16 by 18 in.
Royal octavo,..........	5½ by 7½ do......	12 inch. sq.

The foolscap press, by relieving the large press from doing small work, is found of great utility. The quarto or octavo presses are worked on a table, with great facility, and also excel in taking fac-similes from manuscripts, either in single sheets, or in a book; they are adapted for this purpose without the printing apparatus, and are now preferred to every other invention for

letter copying. They have also been successfully employed in printing from stone.

What is called the Columbian press is formed to operate by a combination of levers, and is perhaps the most powerful of any of those constructed on this mechanical power. This press, which is now very generally introduced, was invented, in 1814, by Mr. Clymer of Philadelphia. Its success in America induced the inventor to come to London in 1818, where he established a press manufactory. The trials that were made with it there, in some of the most extensive printing-offices, soon called the attention of the trade to this ingenious machine. Another press of American invention has been lately imported into this country, and patented by Mr. Barclay. The power in his machine is produced by a wedge acting upon two cylinders, which act again upon inclined planes. The construction of this press is very simple; and it is said to work well, and with much ease to the workman.

OBSERVATIONS ON THE ACT NOW PASSED FOR ASCERTAINING AND ESTABLISHING UNIFORMITY IN WEIGHTS AND MEASURES.

Fraught as this Act is with the most important changes in our commercial transactions that, we believe, ever occurred in the history of the Empire, it is singular that it appears to have excited no interest amongst the mercantile class of the community, and that it has been allowed to slip through Parliament unperceived and unheeded, till it has at length received the final sanction of his Majesty. Some attempts were indeed made by disinterested individuals to call the attention of the public and of the legislature to the nature of this Act while it was proposed in the form of a Bill; but these attempts, it appears, have been as unsuccessful as if they had proposed to alter the laws of the Medes and Persians. To the Commissioners appointed by his Majesty was the whole matter entrusted, and any improvements or alterations that were suggested, though of the most important kind, and, in many instances, by men celebrated for their scientific and practical skill in the country, have been ultimately disregarded. That the individuals appointed to this office are justly ranked among the first philosophers in this, or any other country, at the present day, is sufficiently well known; but that they have, on this occasion, adopted, and at last established a system, or plan, of Weights and Measures, the best adapted for utility and permanency, we must be permitted to doubt.

The system recommended by such men as Hutton, Playfair, Hamilton, Leslie, and Gregory, in our own country, and by Huygens, Laplace, Lagrange, Legendre, Borda, Condorcet, and Delambre, in a foreign one, was, in our opinion, as it must be in that of every impartial judge, entitled to more respect and consideration than appears hitherto to have been paid to it; and we hesitate not to say, that this system, now established in France, will be found in existence long after the one proposed in the Act is buried in oblivion. A system, founded on the nature, or the magnitude of the globe which we inhabit, and

having its scale of Subdivision the same as that of our system of Numeration, which is allowed on all hands to be perfect, must evidently possess a permanency and durability, to which our complicated and imperfect system, partly re-established, and partly amended in the Act, cannot lay the slightest shadow of a claim.

Whether, however, it may be deemed expedient ultimately to enforce this Act, is a question that is worthy of being agitated in Parliament before the period of its enforcement takes place. In the hope that our remarks may reach those who ought to interest themselves in this subject, and have the effect of producing an investigation, and, if practicable, an alteration in this Act, we proceed to explain the nature of some of its leading articles.

It is enacted, in the first and second clauses of the Act, that the old standard yard be retained as the unit of length, with its usual divisions into feet, inches, &c.; and that all the lineal and superficial measures, founded on this standard, remain as they were formerly.

In the third clause, it is enacted, that if this standard yard be lost, or injured, it shall be restored by a reference to the length of the pendulum vibrating seconds in London, at the level of the sea, and in a vacuum. This length, as determined by Captain Kater, one of the Commissioners, in a manner that has conferred on him the highest praise, has been found to be 39.1393 inches. Hence, the length of the yard to that of the said pendulum, is in the proportion of 36 inches to 39.1393 inches, or of the number 360,000 to the number 391,393. From this, it is manifest, that to restore the standard yard, it will be necessary to divide the length of the pendulum into 391,393 equal parts; for since the yard contains 360,000, and the inch 10,000 such parts, neither the one nor the other can be obtained, till the length of the pendulum be so divided.

The extreme difficulty, if not the impossibility of executing, with accuracy, such a minute graduation, must evidently render this mode of ascertaining the length of the standard highly objectionable, in any case, and much more in those cases, where not only the local authorities, but all those about them, are wholly unacquainted with the subject. This difficulty farther shows how much better it would have been to adopt the length of the pendulum at once as the standard yard; for, had this been done, no other graduation would have been necessary than what would have suited the common purposes of life. For these purposes, it is manifest that the decimal division is preferable to every other, insomuch as it would have reduced all our calculations to the operations comprehended in the four common rules of arithmetic.

The bugbears, fear of change and danger of innovation, which have long ceased to possess their strongholds in the minds of men in general, in this enlightened age, still keep their position in the minds of many who are invested with power and authority, and have no slight tenure in those of the minions and satellites who surround them, and perpetually nod assent to their opinions. Hence it is, that the former dread an improvement, or alteration, in existing laws, or practice, lest, thereby, they might lose part of that power, or authority, which it is natural for them to love so well; while the latter, desirous of their own ease, and aware of their own incapacity to act with propriety in such cases, dread any improvement, lest they should thereby lose their situation, or lest it should become an active and honourable

post, instead of being a useless and inglorious sinecure. Such are the only causes which can, with any sincerity, be urged in defence of the preservation of old and absurd systems, and against the adoption of those that are allowed to be new and important. How far these and similar objections against a perfect system of Weights and Measures may be allowed to prevail to the detriment of the community and posterity, it is not for us to say, but we hope the day is not far distant, when a philosophical system will be adopted, without fear of political changes, and when the universal spread of liberal opinions will have taught every class, and every individual of society, to work together for the common good.

The fourth clause enacts, that the old standard Troy, and Avoirdupois pounds, shall be retained and continue to be in use. Here, also, we strongly question the propriety of preserving two different units of weights, as it serves only to perplex and confound, when, unfortunately, in any case, it is not mentioned which of them is meant. Besides, it occasions continually a reduction from the one into the other, when articles are reckoned, as they occasionally are, and will be, by both weights. It must, on these and other accounts that might be mentioned, be perfectly obvious, that the retention of one pound alone, was all that was necessary, and that every other should have been abolished.

That the unit of weight, as well as that of measures of capacity, should be connected with the standard of length, is another obvious principle, which, from the nature of this Act, is entirely overlooked. It is well known, that when a standard of length has been once adopted, standards of weight and of measure *are easily obtained from it*, and, indeed, ought necessarily to be founded upon it. The cube of this standard, that is, the capacity of the vessel having its dimensions in length, breadth, and thickness, the exact length of this standard ought to be assumed as the unit of liquid and dry measures, and the weight of the water, at a fixed temperature, contained in the same vessel, ought to be assumed as the unit of weight.

Contrary to this simple state of the case, the present Act requires, in the same clause, that if the unit of weight shall be lost or destroyed, it shall be restored by a reference to the weight of a cubic inch of distilled water, which has been found to be 252.458 grains, at the temperature of 62° Fahr.; the barometer being at 30 inches. Hence, the weight of the pound Troy, is, to that of the cubic inch of distilled water, in the proportion of 5760 grains, to 252.458 grains, or, as the number 5,760,000, to the number 252,458. Hence, also, we see that the weight of the cubic inch of distilled water must be divided into 252,458 equal parts, before the weight of a penny-weight, (which will contain 24,000 of these parts,) and then that of a pound, can be obtained. To say, that such a division as this, would be difficult, would be saying too little; we may, indeed, safely assert that it is impossible.

A preferable mode of obtaining a pound, having a connection at once clear and simple, with the standard yard, was proposed by Professor Playfair, and it is matter of wonder that it was not adopted. It is well known, that a cubic foot of water, at the maximum density, or 42.3° Fahr., weighs so very nearly 1000 ounces avoirdupois, that the difference is of very little account. Now, were the weight of this cubic foot of water adopted as the unit, or standard of weight,

what an easy matter would it be to refer to it at all times, and what an insensible alteration would it produce. How easy would it be to bring the present weights to this simple standard! A single rub of a file would settle the matter! And how useful would it be, on the other hand, to adopt the cubic foot as the unit of liquid and dry measures, and what a beautifully simple connection would then exist between the weights and the measures! Such a plan was, indeed, too simple to be adopted, for what reason we know not; so we must be content to toil away on the old system, and be thankful it is no worse.

(To be continued.)

MECHANICAL IMPROVEMENTS, USEFUL PROCESSES, &c. &c.

SOLUTION TO THE GEOMETRICAL PROBLEM.

Mr. Editor,—The following is a solution to the geometrical problem proposed at page 211, Vol. I.

Let A B E, fig. 4, be the given circle; A S B, B S C, and C S D the given angles; and A B and C D the given chords:

By Analysis.

About the triangle C S D describe the circle C F D; produce B S to E, and join B D.

Then, since the chord C D and the angle C S D are given, the circle C S D is given; and, since the chord A B and the circle A D E are given, the angle A D B may be found. Again, the angle A S B = the angles S B D, S D B; and A S B and S D B being known, S B D is known, and hence the arcs D F and D E are also known. Now, if the point D be given, the points E and F are known; hence the straight line E F is known, and therefore the points S and B are known. Hence the composition of the problem is obvious.

By Calculation.

Since, when a chord and the radius of a circle are given, the angle at the centre, or circumference, may be found, and conversely; the chord C D and the circle A D E being given, the angle D B C may be calculated; and since the angle S B D is known, the angle S C B is also known. But the angle B S C is given, hence the ratios of S B to B C and of S B to S C are known. Again, the angle S D B, subtended by the given arc A B, is known, and the angle S B D is also known, hence the ratio of S B to S D is known. But the ratio of S B to S C is found, and hence that of S C to S D is known, and the angle D S C is known, therefore the triangle C S D is given in species, and the angles S C D and S D C may be calculated by the formula $\frac{a+b}{a-b} = \frac{\tan \frac{1}{2}(A+B)}{\tan \frac{1}{2}(A-B)}$. The angle S D C being found, S C may be found, and hence in the triangle B S C, B C may be determined.

A. B.

IMPROVEMENT ON THE AIR-PUMP.

Mr. Editor,—The following improvement I invented about three months ago, and I am not aware of the same method having ever been proposed before that time.

The barrel, V V′, fig. 4, is close at both ends, and has valves at V and V′, which open outwards. The barrel communicates with the receiver, by means of the tube C. R is the piston rod, which passes through a

stuffing at T, which is air-tight. The piston, P S, is solid; but, to prevent too much friction, it is air-tight only at P and S. When the piston is in the position in the fig., the barrel below the aperture, A, is filled with air; and, when the piston descends to B, it forces the air out at the valve V′. When in this position, the space above A in the barrel is new filled from the receiver, and the piston, when again elevated, forces this air out at V; and so on alternately. This is perhaps the simplest construction ever proposed; and there are no limits to the degree of exhaustion.

A. B.

Dollar, 4th May, 1824.

IMPROVEMENT ON THE WATER-PUMP.

Fig. 6.—E F is the barrel of the pump, and is surrounded by another cylindric vessel A D, connected with the barrel E F, at the bottom C D. The space between A D and E L is filled with mercury. The cylindric vessel, G K, having another within it, P E, connected together at G and P, acts as a piston. P E has a valve at V, opening upwards. When the piston is made to descend and ascend alternately, the very same effect takes place as in the common pump, observing that the lower extremity of the piston, K H, must not ascend so high as the surface of the mercury at B. When a portion of the air is extracted from the pump E F, the equilibrium between the rarified air within, and the external atmospheric air, is restored by the mercury ascending to I M, between G K and E L. Since the specific gravity of mercury is $13\frac{1}{2}$, when the water in the pump rises to E, the surface M will be higher than the external surface, B, by about ten inches for every twelve feet that E is higher than the surface of the external water at W.

Since in this pump the only power lost arises merely from the resistance of the mercury, which is very inconsiderable, an important advantage is gained over the common pump, in which the resistance from friction, in a pump of four inches diameter, can seldom be less than 12 or 14 lbs. and perhaps more.

If the piston, G K, be made of iron, it might be so thin that only a comparatively small quantity of mercury would require to be employed.

Since the water will rise no higher in the pump than the highest elevation of the valve, *v*, the mercury cannot be injured by oxidation, or any other chemical action occasioned by any substance with which the water may be impregnated; and, since mercury does not amalgamate with iron, at least by mere contact, it will receive no injury from this circumstance. Mercury, however, by continued and constant agitation, being subject to a slight oxidation, may be objected to; but, as the agitation in this case is so trifling, it can scarcely produce any sensible effect. I leave this last circumstance, however, to the consideration of some of your more experienced chemical Correspondents, and shall be happy if any of them can ascertain the extent to which the mercury would be affected.

PERPETUAL MOTION.

A PARADOX.

Let A B C D, fig. 7, be a wheel moveable about an axis, passing through its centre, O; if one-half of it, A B C, be situated in a vessel filled with water, and the other half, A D C, without the vessel; does the half A D C lose as much of its weight as the weight of its bulk of water, and occasion A D C to preponderate and produce a con-

stant motion; or does the wheel remain in equilibrium, and if so, what is the occasion of this paradox?

A. B.

Dollar, 3d July, 1824.

THE PROCESS OF MAKING ATTAR, OR ESSENTIAL OIL OF ROSES.

THIS celebrated essence is obtained from roses by a simple distillation, conducted in the following mode: A quantity of fresh roses, (forty pounds, for instance,) with their calyxes, but with their stems cut short, are put into a still with sixty pounds of water. The mass is well mixed with the hands, and a gentle fire is made under the still. When fumes begin to rise, the cap is put on, and the pipe fixed; the chinks are luted; cold water is put into the refrigeratory, and the receiver adapted. A moderate fire is continued; but, when the water begins to come over, it is gradually lessened. The distillation is carried on till thirty pounds of water are drawn off, which generally happens in about four or five hours. This rose water is poured upon forty pounds more of roses, and from fifteen to twenty pounds are drawn off by the same process as before. This cohobated rose water is poured into pans of earthen ware, or tinned metal, and left exposed to the fresh air for a night; when the *attar*, or essence, will be found in the morning congealed and swimming on the surface of the water: it is to be carefully skimmed off, and poured into a vial. When a certain quantity has been thus obtained, the water and feces are to be separated from the clear essence. The first is easily done, as the essence congeals with a slight cold, when the water may be poured from it. The feces may then be made to subside, by keeping the essence fluid by heat. They are as highly perfumed as the essence. The rose water, after all the essence has been skimmed from it, is to be employed in future operations, instead of common water.

The very small quantity of essence obtainable from the roses in India, has caused various additions to be made in the distillation, particularly sandal wood; but this adulteration is discoverable by the flavour of the sandal, and the fluidity of the oil in common cold. In Cashemire a sweet-scented grass is used as an addition, which does not injure the perfume, but impedes its congelation. The proportion of pure essence yielded by the roses is very variable, from differences in the seasons, and in the manner of conducting the process. In India, three drachms from one hundred pounds of leaves is a large proportion. From a large field of roses, there was procured only at the rate of two drachms to the hundred pounds. The colour of the *attar* is no criterion of its quality. It was obtained green, yellow, and reddish, from roses of the same ground, but collected on different days. The calyxes do not impair the quality of the *attar*, nor give it a green colour.—L. C. P.

ON THE LANGUAGE OF BOTANY.

THE two fundamental principles of Botanical language ought to be—"1st, that we should adhere as closely as possible to the Linnean language itself. 2d, that we should adapt the terminations, plurals, compounds and derivatives, to the structure and genius of our sterling English." By following the first rule, the advantage of an universal language is gained, and with no more difficulty than if terms were invented for the peculiar use of each national language. Yet it admits of this exception; that where a significant English term has been in long and general use, it ought to be preferred. Thus it would be absurd to substitute *folium* for *leaf*, or *semen* for *seed*. Also, when an easy compound word in English can be formed, instead of a sesquipedalian Latin one, it may be preferable; as *funnel-shaped* rather than *infundibiliform*; and the like. The use of the second rule is manifest to give more regularity to our language, and avoid the barbarisms which disgrace it beyond almost any other. Thus Latin terminations in *a*, *us* and *um*, which are foreign to the original nature of our language, should, if possible, be dropt for more analogical ones; and *nectary* may be used for *nectarium*; *style* for *stylus*; *glume* for *gluma*, &c. The English plural in *s* should also be always employed instead of those of the Latin declensions.—T. M.

MAGNETIC MOUNTAIN OF CANNAY.

NEAR the harbour in the isle of Cannay, on a hill of some height called the

Compass-hill, is a hole dug about a foot or two in depth. A compass placed in this hole is instantly disturbed, and veers about to the eastward, till at length the north point settles at due south, and remains there. At a very small distance from the hole, the needle recovers its usual position. This circumstance was known to Martin, when he wrote his history of the Western Islands, but the compass then settled at due east. A discovery was lately made by Hector M'Neil, Esq., tacksman of the island, that the same effect is produced under a rock in the harbour, about half a mile to the south of Compass-hill, and a continuation of it. On a boat's passing under the centre of this rock, almost touching it, the compass veered about to the south. The effect is confined to a very small part of the rock. A piece of the rock below broken off and applied to the compass, produced no alteration. This island has many columnar appearances, like that of Staffa.

G. D.

ON THE PRESERVATION OF ALIMENTS.

ALIMENTS are *dry* or *liquid*. The dry are taken from the *animal* or *vegetable* kingdom. The preservation of the latter is effected by the following modes. Vegetable aliments, consisting of *Grains*, *Fruits*, *Leaves*, and *Roots*, are in general capable of preservation in a salutary state for a year.

The methods at present in use for this purpose, are,

1. Drying by the open air in the shade. This is chiefly employed for medicinal and pot herbs.

2. Drying in the sun, or by a very moderate fire; as used for raisins, currants, figs, and other dried fruits; and sago.

3. Drying in an oven. Other fruits. Hops.

4. Grilling upon clean and moderately heated iron plates. The Chinese prepare tea leaves in this way.

5. Drying by means of a circulation of dry or warm air. M. du Hamel du Monceau proposed granaries, with Hales's ventilators. The Poles and Livonians dry their corn in buildings having a furnace on the ground-floor supplied with air only from beneath, which when heated, passes through the lares of grain on the upper floors, to an opening in the roof.

6. Baking and re-baking in an oven. Biscuit ground and pressed down in iron-hooped casks will keep a number of years.

7. Salting. This is done either with or without fermenting. The former is the method of preparing sour krout.

8. Marinating with vinegar, salt, and pepper. This is practised on some fruits and tender vegetables.

9. Preserving with sugar, the dry and the moist way.

10. Preserving in brandy.

11. Cutting off all communication with the external air, as in covering seeds with wax, &c.

12. Extracting and inspissating the juices of alimentary substances; as in making robs. Portable soup is an animal preparation of this kind.

13. Keeping in dry sand.

Drying in ovens moderately heated, is a mode applicable to a great number of vegetables; as potatoes, turnips, carrots, legumes, apples, pears, plums, and other fruits. No method preserves better all the qualities of the substance, is more easy to practise, or more efficacious. It deserves to be generally recommended. *Drying by the circulation of warm air* is excellent for grains and farinaceous seeds, but inapplicable to other matters. *Salting with fermentation* may be used to all kinds of leaves and roots, and the preparation is a great preservative from the scurvy. It might be made as general as drying in an oven. The other methods belong more particularly to the articles mentioned under them. That of inspissating juices of fruits, &c. is a very effectual mode, but costly, and chiefly fitted for sea shores. None of them can justly be accounted insalubrious.

Of the various modes of preserving *water* sweet, the following is perhaps the best, *viz.* that of filling a cask with water, adding both hands full of quick lime, letting it stand for five or six days, then pouring out the water and rincing the cask, and afterwards putting in the water intended for the voyage. By this method, water was kept perfectly sweet during a six month's voyage to the isles of France and Bourbon. The quicklime was found to have made a thin coating round the inside of the cask.—A. M

SCIENTIFIC INTELLIGENCE.

THE SCRAP GATHERER.

No. 31.—*Preparation of Caoutchouc.*—Mr. T. Hancock has succeeded, by some process, the results of long investigation, but which he has not published, in working caoutchouc with great facility and readiness. It is cast, as we understand, into large ingots, or cakes; and, being cut with a wet knife into leaves, or sheets, about $\frac{1}{8}$ or $\frac{1}{10}$ of an inch in thickness, can then be applied to almost any purpose for which the properties of the material renders it fit. The caoutchouc thus prepared is more flexible and adhesive than that which is generally found in the shops, and is worked with singular facility. The adhesion of the substance in those parts where it is not required is entirely prevented, by rubbing them with a little flour, or other substance, in fine powder. The caoutchouc is, in this state, exceedingly elastic. Bags made of it have been expanded by having air forced into them, until the caoutchouc was quite transparent; and, when expanded by hydrogen, they were so light as to form balloons, with considerable ascending power. But the gas gradually escaped; perhaps through the pores of this thin film of caoutchouc, on expanding the bags in this way, or the junctions yielded like the other parts, and ultimately almost disappeared. When cut thin, or when extended, this substance forms excellent washers, or collops, for stop-cocks, very little pressure being necessary to render them light. Leather has also been coated on one surface with the caoutchouc, and without being at all adhesive, or having any particular odour, and is perfectly water-tight.

32.—*Invisible Cement.*—Isinglass, boiled in spirits of wine, will produce a fine transparent cement, which will unite broken glass, so as to render the fracture almost imperceptible, and perfectly secure.

33.—*Fire and Water-proof Cement.*—To half a pint of milk put an equal quantity of vinegar, in order to curdle it; then separate the curd from the whey, and mix the whey with the whites of four or five eggs, beating the whole together. When it is well mixed, add a little quick-lime through a sieve, until it has acquired the consistence of a thick paste. With this cement, broken vessels, and cracks of all kinds, may be mended. It dries quickly, and resists the action of fire and water.

34.—*To make Gold-colour Varnish.*—Bruise separately four ounces of lacca, as much gamboge, as much dragon's-blood, as much arnotto, and one ounce of saffron. Put each of these into a quart of spirit of wine. Digest them in the sun, or in a moderate heat, for a fortnight. Mix them with clear varnish of sandarac, according to the tint required. Four ounces of aloes, dissolved in a quart of spirit, will also be a good addition to the above ingredients, and give more command over the tint.

QUERIES.

SIR,—In the London Mechanics' Magazine, page 110, "the roots of Veratrum Virea, commonly called Black Hellebore," are said to be "an infallible means to destroy cockroaches." Now, Sir, the Veratrum Virea (Viride) is the green flowering Veratrum, and is in Class Polygamia (23), and Order Monœcia (1). The Black Hellebore is Helleborus Niger, or Christmas Rose, and is in Class Polyandra (13), and Order Polygynia (7). Thus, the names of two plants, quite distinct, are clashed together; which of them is the right plant, or if either is the right plant, I cannot tell—if any of your Correspondents can, they would, by doing so, much oblige,

SIR, your's, &c.
M. A.

P. S.—What is the reason that knots in timber are harder and more durable than any other part of it, when these knots are just the roots of branches?

What is the reason that spring-well water is colder in summer than in winter? And how comes it to pass, that spring wells are frequently found near the summit of hills, but never upon the tops of them?

6th July, 1824.

Iodine and Phosphorus.—"Thenard asserts, that, in the union of iodine and phosphorus, not only caloric, but light, is extricated. But Sir H. Davy states that no light is evolved in this process. Repeated experiments have convinced me of the accuracy of the observation of the British chemist; but it is only justice to M. Thenard to state, that, in the action between

these substances, the evolution of light, as well as of caloric, may be shown, according to the mode of making the experiment. If a small piece of dry phosphorus be dropt into a test-tube, and a quantity of iodine, in its usual scaly form, sufficient to *cover* the phosphorus, be quickly added, an immediate action ensues; the tube becomes hot; fumes of iodine are disengaged; and a deep violet-brown liquid is formed, *without the evolution of light*, even when the experiment is made in a darkened room. But if the proportion of the phosphorus to the iodine be large, and the latter insufficient to cover the former, the action is accompanied by a momentary flash, which I attribute to the combustion of the uncovered portion of the phosphorus in the scanty portion of atmospheric air in the tube. By varying the proportions of the two substances, I can produce the union with or without the extrication of light at pleasure."—*Letter from Dr. Traill to Professor Jameson.*

Luminous Plants.—It is well known that some plants are luminous; and also that parts of plants, in an incipient state of decomposition, shine more or less. The following are remarkable instances of this property: 1. Potatoes, kept in cellars, in a growing state, and therefore useless as food, sometimes become so luminous, that we can read by them the print of a book in the dark. 2. The Dictamnus albus spreads around it, in dry summer evenings, an atmosphere which, on the approach of a taper, inflames with a bright blue flame. 3. Other plants give out a *sparkling light*, probably of an electrical nature; such is the case with the flowers of Calendula, Tropæolum, Lilium bulbiferum and chalcedonicum, Tagetes, Helianthus, and Polyanthes. 4. Some plants give out a calm steady light, of a bluish, greenish, or yellowish-white colour, such as Dematium violaceum, *Pers.*; Schistostega osmundacea, *W.* and *M.*; Phytolacca decandra, Rhizomorpha pinnata, *Humb.*, &c. The luminous appearances in the galleries and shafts of our mines are often to be traced to rhizomorphous plants. 5. The milky juice of some plants is very luminous. 6. Trunks, branches, and roots of trees, in an incipient state of decomposition, become luminous.

Dr. Hare's Method of Impregnating Water with Iron.—If we place a few pieces of silver coin, alternating with pieces of sheet iron, in water, it will soon acquire a *chalybeate taste*, and a yellowish hue, and in twenty-four hours flakes of oxide of iron will appear. Hence, if we replenish with water a vessel in which such a pile is placed, after each draught, we may have a competent substitute for a chalybeate spring.

Clean copper plates alternating with iron, or a clean copper wire entwined on an iron rod, would produce the same effect; but as the copper, when oxidated, yields an oxide, it is safer to employ silver.—Dr. Hare's *Letter to Professor Silliman.*

Bevan's Experiments on the Adhesion of Nails.—In order to determine the force with which nails adhere to wood in which they are driven, Mr. B. Bevan constructed a machine for measuring the force of tension with extensive power. He applied it to the extraction of nails of different lengths, from a quarter of an inch to two and a half inches.

The following were the results obtained by Mr. Bevan, when the nails were forced into dry Christiana deal, at right angles to the grain of the wood:

Kind of Nail.	Number to the lb. avoirdupois.	Inches in length.	Inches driven into the wood.	Pounds required to extract them.
Fine sprigs.........	4560	0.44	0.40	22
Ditto	3200	0.53	0.44	37
Threepenny brads...	618	1.25	0.50	58
Cast-iron nails	380	1.00	0.50	72
Sixpenny nails	73	2.50	1.00	187
Ditto	—	—	1.50	327
Ditto	—	—	2.00	530
Fivepenny	139	2.00	1.50	320

He likewise found, that the progressive depths to which a sixpenny nail was forced into dry Christiana deal, by simple pressure, were as follows:—

A quarter of an inch......... 24 lbs.
Half an inch.................... 76 –
One inch........................235 –
One and a half inch...........400 –
Two inches.....................610 –

New and Curious Mechanical Invention.—David Linnie, from Kirkwall, Orkney, is about to lay an invention before the Society of Arts, which comprises, in the small compass of an ordinary sized walking-stick, a complete fowling-piece, fishing-rod, dog-call, snuff-box, with pen, looking-glass, &c. weighing only about 3½ lb.

It can be used as a walking-stick or fishing-rod, loaded and primed with the greatest safety, and answers its different purposes with utility.

CHEMICAL RECREATIONS;* OR, A SERIES OF AMUSING AND INSTRUCTIVE EXPERIMENTS, &c.—*Third Ed., pp. 238.—Price 3s.*

It is a pleasing evidence of the increasing desire for knowledge amongst mechanics, that this little work, written by one of their number, and designed for their use, has arrived at a third edition. The cheapness of the book, no doubt, as well as the great quantity of useful matter which it contains, are qualities sufficient to render it popular. The approbation which it has already met with, from some of our leading Journals of Science, renders it unnecessary for us to say more to recommend it to the young student of Chemistry; we shall, therefore, only offer a few remarks explanatory of its contents, from which we formerly gave some very useful extracts. The author commences with a plain and simple exposition of the principles of the Science, which he denominates "First Lines of Chemistry." Under this head, he explains its nature, and informs his readers, very justly, that the most important step to acquire a knowledge of it is "*to make experiments.*" He then proceeds to give a simple and clear account of the properties of Simple Bodies, as Gases, Metals, &c. He next treats of the Powers which produce Chemical Phenomena, such as Attraction, Repulsion, Caloric, &c. and gives a short explanation of the Atomic Theory. Compound Bodies are then explained, including Acids, Alkalies, Earths, Oxides, Salts, Minerals, &c. to which is subjoined a Sketch of Natural History, including the subjects of the Vegetable and Animal Kingdom.

The second part of the work contains a description of Chemical Processes and Apparatus; and this part is executed in a very plain and instructive manner. Many useful hints are thrown out to the student how to procure experiments in the easiest way, and at the least possible expense. The price of almost every article, and chemical substance requisite for performing experiments, is stated, a thing which must render the work extremely useful.

The third part consists of Experiments, which are uniformly explained, with a constant reference to first principles. It is throughout interspersed with remarks frequently amusing, and always judicious, though not without an occasional sprinkling of the marvellous. These experiments are arranged under the following heads: Experiments illustrative of the properties of Heat; Chemical Affinity; Gases; Salts; and Tests; Experiments on the Arts and Domestic Economy; Combustion; Detonation; Light; &c. We shall conclude our short notice of this interesting little work, with the following extract, as a specimen of the easy style in which it is composed:

Salts.—These are compounds of acids, in definite proportions, with alkalies, earths, and metallic oxides. They form a very numerous, and very important class of chemical bodies; and the study of their composition and properties must occupy a large share of the learner's attention. Nothing can give such clear ideas concerning the nature of chemical changes, so well explain the laws of affinity, and exhibit to advantage the doctrine of definite proportions, as the synthesis and analysis of salts. There is another thing also which may be mentioned here, as it serves to show with what facility some parts of chemical knowledge may be acquired. The student, on being told that the number of salts amounts to several thousands, might be terrified into the opinion, that it would be scarcely possible to remember even the *names* of so many bodies. But when he is shown how philosophically these bodies have been arranged, and how excellently named, he will perceive, that the learning and remembering—not only their names, but their constituent principles

* Richard Griffin & Co., Glasgow.—1824.

also, is a task of but little difficulty. To illustrate this,

Let the student be told, that every salt has a double name: one part of it intimating the acid of the compound, and the other, the particular base. Let him also be told, that the terminations of the names of the salts invariably agree with the terminations of the names of their components; and then the nomenclature of salts will be perfectly intelligible. Thus, if an acid, whose name ends in IC, as sulphur*ic* acid, combines with a base, as soda, and forms a salt, the part of the name of that salt which intimates its acid constituent, will end in ATE; the compound being a *sulphATE*. But, on the contrary, if the salt be formed by an acid ending in OUS, as sulphur*ous* acid, then the name of the salt ends in ITE, as *sulphITE of soda*.

The salts which end in *ite*, like the acids they are formed from, are generally of very little value.

When the proportions of the constituents of a salt are so adjusted, that the resulting substance does not affect vegetable colours, it is called a *neutral* salt. When an alteration of colour evinces a predominance of acid, the salt is said to be acidulous, and the prefix *super*, or *bi*, is used to denote the excess of acid. If, on the contrary, the acid matter appears to be in defect, or short of the quantity necessary for neutralizing the properties of the base, the salt is then said to be with excess of base, and the prefix *sub*, is attached to its name.

USE OF THE CAMERA OBSCURA.

An occurrence originated in a Camera Obscura exhibited here during the Fair week, which shows the important use to which this amusing optical apparatus may be applied. A person happened to be examining, with great interest, the various lively and ever shifting figures which were pourtrayed upon the white tablet during the exhibition, when he beheld, with amazement, the appearance of one man picking another man's pocket. Perfectly aware of the reality of this appearance, he opened the door, and recognizing the culprit at a short distance, ran up and seized him in the very act of depredation. It is, perhaps, unnecessary to add, that he was immediately handed over to the Police. From this circumstance, the utility of placing such apparatus in all places of public amusement and exhibitions, must be obvious. Whether it might be proper to erect it in the streets of a populous city like this, and to place it under the inspection of an officer for the detection of mischief and crime, is a matter worthy of the consideration of the local authorities. Would it not be an eligible plan, indeed, to employ the Camera Obscura of the Observatory, (which is not otherwise in use,) to take a view of what is passing in the streets in town, and communicate the result, if necessary, to the Police Office or the Jail, by means of a telegraph? If the Observatory be considered too far off, the apparatus could be fixed up near the top of the Tron or Cross Steeple. By this means, the necessity of sending out emissaries to reconnoitre the conduct of the lieges would be superseded, since every thing thing would then take place, as it were, under the eye of the Police; and, if any impropriety or misconduct were observed, it would only be necessary to send a *posse* to the particular spot where it happened.

Z.

NOTICES TO READERS AND CORRESPONDENTS.

A NEW PLAN of propelling paddles for STEAM BOATS, invented by Mr. THOMAS CLARK, Glasgow, will appear in our next.

G. M., and J. A., under consideration.—A Plain Mechanic will have every attention paid to his communication.—Some of our old and respected Correspondents must really excuse us, on account of a press of important matter. The Gallowgate Grocer may send to all the Professors of Mathematics in Europe if he chooses, but his Plagiarism will be detected and exposed in our next.

ERRATA.

Vol. II. page 3, col. 1, line 26, *for* "Not that," *read* "Not but that."—Page 5, col. 2, line 27, *for* "Wicksworth," *read* "Wirksworth."

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written. Original Patents, Inventions, &c. will be inserted on the shortest notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of Steuart & Panton, Cheapside, London; and Edward West & Co. Edinburgh.

J. CURLL, PRINTER.

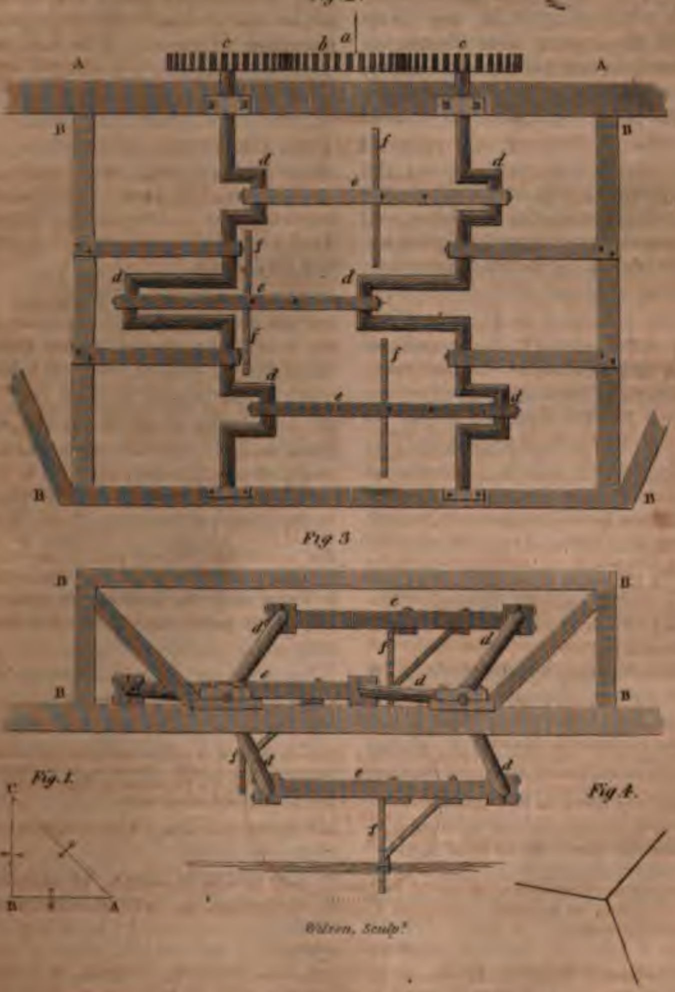
THE GLASGOW MECHANICS' MAGAZINE.

"One of the greatest services which government could render to society, *would be* —the adoption of a system of measures, whose uniform divisions are most easily adapted to calculation, and which are derived, in the least arbitrary manner, from a fundamental standard indicated by nature herself."—*Laplace*.

No. XXXIII. *Saturday, 14th August,* 1824. Price 3*d.*

Mr. CLARK's PROPELLING PADDLES FOR STEAM BOATS.

Fig 2.



ON A NEW PLAN OF PROPELLING PADDLES FOR STEAM BOATS.—By Mr. Thomas Clark, Glasgow.

Sir,—In the common wheel-paddles at present employed for propelling steam boats, there are, it appears to me, two defects, which are yet left to the ingenuity of the mechanic to remove.

In the first place, they are defective, on account of the declivity with which they enter and come out of the water. For illustration of the defect arising from this cause, let us take any line, A B, (fig. 1,) which is parallel to the surface of the water. From the extremity of A B, draw A C, representing the inclination of a paddle on entering the water, and also the length of the paddle immersed in the water. A C, consequently, represents the *force* which must be applied by the moving power of the paddle. From the point C, draw C B perpendicular to A B.

Now, A C representing the force applied by the moving power, it follows, by a well-known law in Mechanical Philosophy, that the *resistance* which it meets will be represented by A B and B C. A B will represent the resistance upwards; B C, the resistance horizontally. Hence, with regard to propelling effect, A B is lost, and B C alone efficient.

Now, supposing the angle at A to be 45°; then, the angle at C will also be equal to 45°; and A B will be equal to B C: that is, the resistance lost and the resistance efficient will be equal. Hence, at this inclination, whatever be the force A C represents, *one-half* of it is lost.

Again, supposing the angle at A to be equal to $63\frac{1}{2}°$; then, the angle at C will be equal to the difference between this and 90°; that is, to $26\frac{1}{2}°$. In this case, A B is to B C as 1 is to 2: that is, the resistance lost is to the resistance efficient, as 1 is to 2. Hence, supposing the force A C to be represented by 3; then 2 would represent the force efficient, and 1 the force lost. We conclude, therefore, that at the inclination of $63\frac{1}{2}°$, *one-third* part of the force applied is lost.

In like manner, it might be shown, that at the inclination of $71\frac{1}{2}°$, *one-fourth* of the force applied is lost; at 76°, *one-fifth*; at $78\frac{3}{4}°$, *one-sixth*; at $80\frac{1}{2}°$, *one-seventh*; and so on, diminishing as we approach the perpendicular, where alone the whole force applied is efficient.

In the second place, wheel-paddles are defective, owing to the following cause: The successive paddles are commonly placed very near one another. Hence, when one paddle enters the water, it leaves, by its swift motion, a current, into which the next paddle enters; but which instead, as is desirable, of moving in an opposite direction to the paddles, moves in the same. Great resistance is thus lost.

To remedy the former of these defects, several attempts have been made in this country. These attempts, however, have commonly been unsuccessful, on account of the great contingency of force which steam boat paddles are called to bear. This renders them altogether incompatible with that intricacy and instability of machinery, which are not wanting in some of the professingly improved plans which have been proposed, but which, on this consideration, have been rejected or abandoned.

The latter of the defects which I have stated, has not, however, so far as I am aware, met the attention of the mechanics of this country. The only attempt to remove it, of which I ever heard, was one of a Dutch mechanic, who, long

ago, employed the following plan for this purpose: His wheel-paddles were each composed of two, being, as it were, double. Each of the single wheels, composing the double ones, had its paddles at a considerable distance from one another; and the two single wheels were so joined into a double one, that every paddle in each single wheel was at a middle distance between two paddles, in its neighbouring single wheel. This plan, which was employed on canals, in boats, propelled by the force of men, was, I have been informed, attended by a considerable increase of power.

About two years ago, I made some attempts at the removal of these defects. The following is an account of one of the plans, which occurred to me, to effect this, and which I send to you, not under the impression that the improvement will practically be found to be very great, but in the hope of attracting attention to the subject, and in the conviction, that, in submitting it, through you, to the consideration of the Mechanics of Glasgow, I am laying it before those who are best qualified to judge of its utility, and to add to it those improvements and modifications, of which, for practical application, it may stand in need.

Fig. 2 is a plan of the machine; fig. 3 is a sectional view. The same letters refer to both. A A (fig. 2,) is the side of the boat. B B, B B (figs. 2 and 3,) is the frame to support the machinery. *a* is the shaft, which turns the wheel *b*, whose teeth run into those of the wheels *c c*, and turn both in the same direction. These wheels are connected, by a shaft, with the double cranks *d d d*, *d d d*. These cranks are inclined to one another, at equal angles, as shown in fig. 4; and they are of equal lengths. *e e e* are bars, connecting these cranks in such a manner as to preserve the corresponding cranks, on the different shafts, parallel to one another, as better shown in fig. 3. *f f f* are paddles affixed perpendicularly to these bars. These paddles alone, or the paddles and the bars together, may be so fixed, as to be removable at pleasure.

From this description, it is evident that the cranks on the same shaft will always preserve the same inclination to one another; that the corresponding ones, on different shafts, will always be parallel; that the bars connecting them will always be horizontal; and, consequently, that the paddles must always enter, pass through, and rise out of the water, perpendicularly to its surface. The terminations of the paddles move in a circle, as represented in fig. 3 by a dotted line. The radius of this circle is equal to the length of any of the several cranks. It is evident, also, that every successive paddle enters in a current, different from that caused by the one which it follows.

Thus, it appears, both the defects are avoided, which I have mentioned, as belonging to wheel-paddles, at the expense, indeed, it is to be admitted, of some additional friction, and of a degree less of stability. The latter defect, however, is, I apprehend, more than compensated, by the ease with which the machinery admits of being stripped of the paddles and bars; and, were it otherwise, it is, in no respect, an objection to the introduction of the plan in boats, of which the navigation is confined to rivers.

Farther points of description, and other modifications of the machine, are so evident from an inspection of the figures, that I consider it unnecessary farther to intrude on your room.

I am, SIR, your's, &c.

Thomas Clark.

Bath-Street, 6th August, 1824.

OBSERVATIONS ON THE ACT
NOW PASSED
FOR ASCERTAINING AND ESTABLISHING UNIFORMITY
IN
WEIGHTS AND MEASURES.

(Concluded from page 41. Vol. II.)

The sixth clause enacts, that the standard for all liquids and dry goods (not measured by the heap) shall be the gallon containing 10 lb. Avoirdupois weight of distilled water, weighed in air at 62° Fahrenheit, the barometer being at 30 inches. This is the most important clause in the whole Act, and indeed may be said to be the only one which will occasion a radical change in many important departments in trade and commerce. On this account, it ought to have been proposed with great caution, and with a view to our credit as a scientific nation, and to the comfort both of the present race and their posterity. What is the use of partial and patchwork plans to meet the exigencies of the community, compared with that of a systematic and scientific arrangement of Weights and Measures, founded on an invariable basis and a regular system of division? The ten pound, or imperial gallon as it is called, does not contain an exact number of cubic inches. Now, we would ask, whether were it not better that it should contain an even number of cubic inches, and an odd number of pounds; or an even number of pounds and an odd number of cubic inches? Scientific men, in general, prefer the former; and why? because it is easier to construct a cubic measure for the one, than for the other. This was, at least, Professor Playfair's opinion, and that of many others which might be quoted. There is another reason too, and one of perhaps greater importance, namely, that it is easier to calculate the contents of vessels in the one case than in the other, because they are invariably connected with the standard of length. In this Act it may be said that the standard of capacity is not connected with that of length at all.

To find the content of this gallon, it is necessary to refer to the fifth clause of the Act, where we have the weight of a cubic inch of water given in grains; hence we find the number of cubic inches in the gallon, by the following proportion: 252.458 grains : 1 cubic inch :: 10 lb. or 70,000 grains : 277.273 cubic inches, which is the content of the imperial standard gallon.—Though the identification of this gallon is thus remotely connected with the standard of length, and apparently still more so with the pendulum itself, as we have already shown; yet we may mention that the content of the cube of the SIXTH part of the pendulum vibrating seconds in London, is so very near that of this imperial gallon, that the difference is only about $\frac{3}{10}$ of a cubic inch. Now this difference is so small, that the one may be reckoned a sufficient identification of the other; a circumstance which brings this gallon much nearer to a fixed and invariable standard than, we believe, was ever thought of. We may also remark, that though the temperature was not fixed at the maximum density, (*i. e.* 42.3° Fahrenheit,) as it ought to have been, to be independent of thermometric graduations; yet it likewise happens, that the temperature has been fixed at a point above the freezing

point, (62° Fahrenheit,) which is exactly the SIXTH part of the distance between the freezing and the boiling points. The connection of these two facts will render these standards so far invariable in future; 1st, that the cube of the SIXTH part of the London pendulum is extremely near the imperial standard gallon; and 2d, that the tenth-part of the weight of an imperial standard gallon of water at a temperature above that of freezing, exactly the SIXTH part of the distance between the freezing and the boiling points, is an imperial standard pound.

It is perhaps unnecessary to state, though some of our readers may not be fully aware of it, that by this clause the standard wine gallon of 231 cubic inches, the standard ale and beer gallon of 282 cubic inches, the standard corn gallon of 268.8 cubic inches, or the standard Winchester bushel of 2160.42 cubic inches, the standard Scotch pint of 104.434 cubic inches, and the standard Scotch wheat and barley firlots, with all other local measures of every description, are to be completely abolished. How far it may be adviseable or practicable to bring this change about, will be seen on or before the 1st of May, 1825; as for ourselves, we much doubt whether it will ever take place.

The seventh clause enacts, that the standard bushel, raised of course from the imperial gallon, shall contain 8 such gallons, or 80 pounds Avoirdupois of water, as aforesaid; and that it shall be made round, with a plain and even bottom, and being 19½ inches from outside to outside. The eighth clause then enacts, that in heaped measure this bushel shall be duly heaped up in the form of a cone to the height of six inches. Now, we would ask, where is the use of retaining heaped measure, which is so liable to frauds, and so troublesome in operation, when such a fine opportunity occurs of abolishing it altogether? This is what we would call accommodating the Act to the prejudices of the people, contrary to the dictates of sound judgment. Would it not be better to enact that coals and other goods commonly sold by heaped measure, be sold by unheaped measure, where no such opportunity for fraud would occur? Or, (which would be much more preferable) to enact that they be sold by weight, a plan which is now generally followed in this part of the country, and which completely prevents all attempts at fraud? The clause does not mention how high the cone is to be raised in the half bushel and other parts of the bushel. If we are to suppose that they are to be raised in proportion, it will take a more intricate calculation than most people are able to perform, to determine that proportional height, as well as the diameter of the cone or mouth of the vessel to be employed. We are also at a loss to conceive what is meant by the bushel "being 19½ inches from outside to outside," unless it be the diameter of the mouth; and if so, it appears very strange why it is not expressed.

In conclusion, we may remark, that if ever this Act be enforced, it will not be necessary for the local authorities, in a city containing so many scientific characters as ours does, to procure any of the new standards, if they have carefully preserved the old. All that they have to do, is to search out for the standard Avoirdupoise pound sent down at the Union, to cause ten such pounds to be accurately constructed, and then to cause a vessel to be made which shall contain the weight of these ten pounds of water of the required purity and temperature. There are surely men in Glasgow, celebrated as it is for its

mechanical as well as scientific characters, who can do all this, and much more if it were necessary.—It is not any one, however, that can perform the requisite operations with that caution and sagacity which ought to preside over such an important branch of municipal affairs. In the construction of an accurate set of weights and measures, the most accurate philosophical instrument makers, chemists, and natural philosophers, ought to be employed, and in this city there are names celebrated in these departments all over Europe.

APPLICATION OF MECHANICS TO THE ARTS.

(Continued from page 459, Vol. I.)

A vulgar prejudice tends to confirm those who pursue the phantom of ridiculous invention, in their foolish dream of success. It is commonly supposed that the greatest mechanical discoveries are the result of chance; that the most celebrated mechanicians had no theoretical knowledge; and, in fact, that even famous mathematicians have failed when they attempted to put their schemes in practice. We mean not to deny that chance is pleased sometimes to reveal important phenomena, and that useful results do not always follow the laborious investigations of the theorist; but it is necessary for this, that the productive causes be of the very simplest kind; it is necessary that, independent of every fixed and determinate proportion, they require no preliminary preparation. It was thus that the fortuitous mixture of some substances gave birth to important chemical combinations. It was thus that two convex lenses, placed parallel to each other at a certain distance and directed to a distant point, indicated the principle of the telescope. Every time that this simplicity does not exist; every time that causes, necessarily complicated, require the occurrence of several circumstances according to given laws, it is absurd to suppose that chance could have any influence.

If chance can only produce discoveries in cases extremely rare, what then must be the blindness of those men, destitute of knowledge, who obstinately wish to attempt what the most able and learned men have judged impracticable? What must be their madness in flattering themselves that they shall obtain, without sufficient knowledge, that which required the application of the most refined and accurate theories? Their phrenzy is no less ridiculous than that of an ignorant rustic who should compose an epic poem, and flatter himself that he had rivalled a Milton; or that of a miserable dauber, who, without the principles of drawing, should fancy that he equalled a Hogarth.

Some famous mechanicians are said to have been ignorant of theoretical knowledge. Before answering this objection, it will be necessary to state some principles, and to give some definitions. What is a theory? A theory is nothing else but a regular union, or methodical and connected arrangement of all the facts relative to a certain natural or artificial effect; and these facts are obtained by experience. A theory can be obtained in two ways: by study, and by a long experience directed by an accurate and penetrating mind. There may be as many theories as there are natural or artificial effects. The knowledge of one theory does not necessarily suppose that of another, although some have an affinity and a kind

of common filiation. There is no doubt that many eminent mechanicians have possessed a very circumscribed knowledge, which did not extend beyond practical mechanics, and which even embraced but a particular branch. They have never attempted to overleap these just limits; but they were profoundly acquainted with a theory which was complete, accurate, and solid in that part to which they had uniformly directed their attention. They had acquired nothing by study; experience alone revealed to them all the relative facts of any importance, all the details of any utility. The penetration of mind, the accuracy of judgment, had disposed these facts in their understanding according to their mutual dependence. The little extent of their knowledge has perhaps contributed to give them more depth. It is, however, probable, that a more considerable sum of knowledge would not have been useless to them, and would have enabled them to render greater services to the Sciences and the Arts.

The misfortune of some able mathematicians, who have failed in some practical operations, does not prove at all that the abstract sciences are useless, as some practical men, of small attainments, affect to say; but it proves only that these sciences are not sufficient in themselves to direct practical operations; and that, to be productive, it is necessary that they be combined with experimental knowledge. It is by intimately connecting the one with the other that we can assure ourselves of obtaining results really useful and satisfactory.

We conclude, from this discussion, that no one can pretend to perfect or extend the domain of science, until after he has acquired the necessary knowledge by study, or by a practice well understood, and not the effect of mere routine. If you are animated by an extraordinary tendency to mechanics, if genius inflames you, if, in short, nature has bestowed upon you this gift so rare, which she only grants to some privileged beings; know that genius is, without doubt, a very precious germ, but one which requires careful culture to produce fruit; know that if this germ is confided to a barren soil, it will probably be choaked with creeping and noxious weeds; and if endowed with an extraordinary vigour, it will succeed in developing and in producing fruits; but these fruits, harsh and wild, will never have that admirable beauty, that exquisite savour which they only obtain by culture, and which is the reward reserved for the ability and the patience of the good cultivator.

If it be remarked, with surprise, that the study of practical mechanics is frequently neglected by persons who ought to apply themselves with the greatest ardour, it is to be attributed to the multiplied difficulties with which this study has to this moment been environed. The various kinds of knowledge which belong to it are still scattered, without order and without connection. No person has attempted to connect them, to class them, and to form them into a body of doctrine, at once regular and methodical. These branches of knowledge ought to be arranged in such a manner, that their mutual dependence may be recognised, that they may be compared with facility, and that from them clear and lasting ideas may be gained. To attain this end, it will be necessary to discover at first, with care, all the effects which machines can produce, and the different methods invented to construct them; to examine, at the same time, the respective advantages and defects of these me-

thods, according to the results best founded on theory and experience.

In following this plan, it is necessary to decompose machines into their primitive parts—and to imitate the anatomist, who, to acquire a deep knowledge of the structure and the vital functions of animated bodies, decomposes them into all their organic parts, analyzes them exactly, examines them separately, and makes himself acquainted with the forms, the disposition, and the mode of existence of each of them; then he compares them, and discovers the admirable artifice of their various combinations. A similar plan ought to be followed with respect to machines—which are in general too complicated to allow us, without the aid of decomposition, to attain accurate, distinct, and, above all, permanent ideas of them. It is not sufficient, to arrive at this result, to decompose some of them separately; we must submit the whole at once to analysis. This simultaneous analysis would seem at first impracticable; but, if we reflect on it for a little, we shall immediately discover that it is not only possible, but easy.

It is evident, that the elements which produce the same partial effects ought to be always similar in different machines. Thus, a wheel, driven by the wind, or the force of steam, will be the same, in whatever way they may be employed. Toothed wheels will also always have the same forms, and the same arrangement, while they serve the same purpose, although they may be employed in machines essentially different from each other.

The first procedure, in the analysis of mechanical elements, is to observe, that every machine requires a *moving power*. Then, that there are many classes of moving powers, namely, animal strength, water in its natural state, steam, the wind, springs and weights, and some others of limited use. These classes can be subdivided into genera, the genera into species, and the species into varieties. Thus, for example, the first class of moving powers contains two genera, man and animals, such as the horse, the ox, and some others. Each of these two genera contains many species, which are determined by the various ways of applying the action of men or animals to machines, either causing it to act by their weight or muscular force, or by the combination of both. The species contain varieties resulting from less sensible differences, which are related to one another from the characteristic actions of each species. By following, in all the classes of moving powers, the same method, we obtain the complete classification of the effects which they are capable of producing.

If, moreover, we attend to the organs which receive the action of the moving powers, and which may be denominated *recipients*, their classification will be identically the same.

It is also to be remarked, that the moving powers are often at a distance from the place or the action of the machine which is put in motion; then organs of transmission become necessary. These organs, which are of two kinds, may be denominated *communicators*. The one can only transmit the motion at a limited distance; the other are endowed with the power of transmitting it to any distance. This striking difference determines the division of the order of communicators into two classes. But it is not merely sufficient that the communicators transmit the motion, they have still another function to fulfil; for the quality of the motion which the moving power impresses on the recipient is not always of

the same nature with that which is wanted by the final action of the machine. It is thus that, in a hydraulic machine, where the pumps are driven by a mill-wheel, the moving power produces a circular vertical motion, while the pumps have a motion alternate rectilineal; it is then necessary that the communicators, at the same time that they transmit the motion received by the wheel to the pumps, should cause them to experience the requisite transformation of motion. The different kinds of transformations, and the different structures of the organs, furnish the means of determining the genera, the species, and the varieties.

It rarely happens that the moving power has the degree of speed requisite for the final action of the machine. For example, in grinding-mills, driven by wind or water, the fly, or wheel, has in general only a speed five or six times less than that which the mill-stone ought to have. Besides, it is often necessary to produce a great effect, although we have only a small disposable force. To produce these effects, some organs are employed to modify the two elements which compose the motion; namely, the force and the speed, by increasing the one and proportionally diminishing the other. These organs, which may be denominated *modifiers,* compose the third order, which is distributed into six classes, namely, the lever, the simple and compound pulleys, the wheel and axle, the screw and wedge, and the hydraulic press.

It is often necessary to effect several motions in a contrary direction, at the same time, and in the same machine; in such cases, we must dispose the parts so as to be entirely free, without which they would otherwise cease to have that mutual communication and dependence which the nature of the machine requires.

The supports, disposed and constructed in such a manner as to favour all these effects, constitute the fourth order.

The fifth order includes *regulators,* distributed into three classes, namely, *moderators*, *governors*, and *correctors.* The moderators have, for their end, the reduction of the motion to uniformity. The governors regulate the motion, with respect to its duration, its speed, and its extent; and direct the interruptions, the re-commencements and the periodic variations of the motion; the correctors diminish and prevent the prejudicial effects of passive resistance.

The sixth, and last order, contains the organic parts which operate immediately on the resistance. These parts act either by loco-motion, pressure, percussion, friction, or finally by separation. Such is the general plan of classification which ought to be followed in a system of practical mechanics.

PHILO-MECHANICUS.

MECHANICAL IMPROVEMENTS, USEFUL PROCESSES, &c. &c.

MR. CHURCH'S PRINTING MACHINERY.

THE printing apparatus invented by Mr. Church, of the Britannia Works, Birmingham, forms perhaps the most extraordinary combination of machinery that has for a long time been submitted to the public. It consists of three pieces of mechanism. The *first* of these has for its object the casting of metallic types with extraordinary expedition, and the arrangement of them for the compositor. By turning a handle, a plunger is made to displace a certain portion of fluid metal, which rushes with considerable force, through small apertures, into the moulds and matrices by which the types are cast.

The farther progress of the machine discharges the types from the moulds, and causes them to descend into square tubes, having the shape of the types, and down which they slide. It then brings the body of each type into the position required for placing it in the composing machine; and when the types have descended in the guides, they are pushed back by the machine into ranges, each type preserving its erect position. The machine then returns into its former state, and the same operation is renewed. The construction of the mould-bar is the most striking portion of the machine.

The *second* machine selects and combines the types into words and sentences. The several sorts of types are arranged in narrow boxes or slips, each individual slip containing a great number of types of the same letter, which is called a file of letters. The cases containing the files are placed in the upper part of the composing machine; and by means of keys like those of a piano-forte, the compositor can release from any file the type which he wants. The type thus liberated is led by collecting arms into a curved channel, which answers the purpose of a composing stick. From this channel they may be taken, in words or sentences, and formed by the hand into pages, by means of a box placed at the side of the machine.

The *third* machine, for taking off impressions from the types, evinces much ingenuity; but cannot be understood without several drawings.

After the types have been used, and the requisite number of impressions obtained, they are remelted and recast as before, so that every sheet is printed with new types.—*Brewster's Journal.*

ON MAGNETISM AND A NEW THEORY OF THE EARTH.

It frequently happens, that individuals, separated by distance of time and place, and unacquainted with each other's writings, fall upon the same ideas in the course of their investigations on the same subject. An occurrence of this kind, when the distance of time is very small, often leads to serious and protracted disputes, respecting originality of discovery, especially when the subject in question is one of great importance; but when this is not the case, it matters little indeed who is the original discoverer. We were led to these remarks, from a discovery that we made the other day, in looking over a letter, in the Transactions of the American Philosophical Society, from Dr. Franklin to Mr. Bodoin, relating to Magnetism, and the Theory of the Earth; we there found that we had been anticipated in our former remarks on Magnetism, p. 104, vol. 1. when we supposed that this power might exist in the moon, or be extended through the solar system. We also found that a famous hypothesis, of a well known townsman, respecting the Theory of the Earth, had been in like manner anticipated by the aforesaid learned Doctor.

For the instruction of our readers, and the consolation of those who have been anticipated in their ideas, we insert these queries, &c. as they cannot fail to be interesting to all parties. Perhaps these queries may have anticipated the original ideas of more individuals than we are aware of; indeed, something runs in our mind that this is the case; if so, perhaps, some of our Correspondents will have the kindness to inform us.

"Has the question, how came the earth by its magnetism, ever been considered?

Is it likely that *iron ore* immediately existed when this globe was first formed; or may it not rather be supposed a gradual production of time?

If the earth is at present magnetical, in virtue of the masses of iron ore contained in it, might not some ages pass before it had magnetic polarity?

Since iron ore may exist without that polarity, and, by being placed in certain circumstances, may obtain it from an external cause, is it not possible that the earth received its magnetism from some such cause?

In short, may not a magnetic power exist throughout our system, perhaps through all systems, so that if men could make a voyage in the starry regions, a compass might be of use? And may not such universal magnetism, with its uniform direction, be serviceable in keeping the diurnal revolution of a planet more steady to the same axis?

Lastly, as the poles of magnets may be changed by the presence of stronger magnets, might not, in ancient times, the near passing of some large comet, of greater magnetic power than this globe of ours, have been a means of changing its poles, and thereby wracking and deranging its surface, placing in different regions the effect of centrifugal force, so as to raise the waters of the sea in some, while they were depressed in others?

Let me add another question or two, not relating indeed to magnetism, but, however, to the theory of the earth.

Is not the finding of great quantities of shells and bones of animals, (natural to hot climates,) in the cold ones of our present world, some proof that its poles have been changed? Is not the supposition, that the poles have been changed, the easiest way of accounting for the deluge, by getting rid of the old difficulty how to dispose of its waters after it was over? Since, if the poles were again to be changed, and placed in the present equator, the sea would fall there about fifteen miles in height, and rise as much in the present polar regions; and the effect would be proportionable, if the new poles were placed any where between the present and the equator.

Does not the apparent wrack of the surface of this globe, thrown up into long ridges of mountains, with strata in various positions, make it probable, that its internal mass is a fluid; but a fluid so dense as to float the heaviest of our substances? Do we know the limit of condensation air is capable of? Supposing it to grow denser *within* the surface, in the same proportion nearly as we find it does *without*, at what depth may it be equal in density with gold?

Can we easily conceive how the strata of the earth could have been so deranged, if it had not been a mere shell supported by a heavier fluid? Would not such a supposed internal fluid globe be immediately sensible of a change in the situation of the earth's axis, alter its form, and thereby burst the shell, and throw up parts of it above the rest? As, if we would alter the position of the fluid contained in the shell of an egg, and place its longest diameter where the shortest now is, the shell must break; but would be much harder to break if the whole internal substance were as solid and hard as the shell.

Might not a wave, by any means raised in this supposed internal ocean of extremely dense fluid, raise, in some degree, as it passes, the present shell of incumbent earth, and break it in some places, as in earthquakes? And may not the progress of such wave, and the disorders it occasions among the solids of the shell, account for the rumbling sound being first heard at a distance, augmenting as it approaches, and gradually dying away as it proceeds? A circumstance observed by the inhabitants of South America, in their last great earthquake, that noise coming from a place some degrees north of Lima, and being traced, by enquiry, quite down to Buenos Ayres, proceeding regularly from North to South, at the rate of — leagues per minute, as I was informed by a very ingenious Peruvian whom I met with at Paris."—B. F.

PROCESS OF MAKING LARGE SHEETS OF PAPER IN THE CHINESE MANNER, WITH ONE SMOOTH SURFACE.

In Europe, to have a large surface of paper connected together and smooth on one side, the following operations are performed: A number of small sheets are to be made separately. These are to be couched one by one, between blankets. When a heap is formed, it must be put under a strong press, to force out the water. Then the blankets are to be taken away, one by one, and the sheets hung up to dry. When dry, they are to be again pressed, or, if to be sized, they must be dipped into size made of warm water, in which glue and alum are dissolved. They must then be pressed again, to force out the superfluous size. They must then be hung up a second time to dry, which, if the air happens to be dry, requires some days. They must then be taken down, laid together, and then pressed. They must be passed together at their edges. The whole must be glazed by labour, with a flint.

In China, if they would make sheets, suppose of four and an half ells long, and one and an half ell wide, they have two large vats, each five ells long and two ells wide, made of brick, lined with a plaster that holds water. In these the stuff is mixed ready to work.

Between these vats is built a kiln, or stove, with two inclining sides; each side something larger than the sheet of paper; they are covered with a fine stucco that takes a polish, and are so contrived as to be well heated by a small fire circulating in the walls.

The mould is made with thin but deep sides, that it may be both light and stiff: it is suspended at each end with cords that pass over pullies fastened to the ceiling, their ends connected with a counterpoise nearly equal the weight of the mould.

Two men, one at each end of the mould, lifting it out of the water by the

help of the counterpoise, turn it and apply it, with the stuff for the sheet, to the smooth surface of the stove, against which they press it, to force out great part of the water through the wires. The heat of the wall soon evaporates the rest, and a boy takes off the dried sheet by rolling it up. The side next the stove receives the even polish of the stucco, and is thereby better fitted to receive the impression of fine prints. If a degree of sizing is required, a decoction of rice is mixed with the stuff in the vat.

Thus the great sheet is obtained, smooth and sized, and a number of the European operations saved.

As the stove has two polished sides, and there are two vats, the same operation is at the same time performed by two other men at the other vat; and one fire serves.—B. F.

ON THE ECONOMICAL USES OF CAST IRON.

In several mechanic arts, masses of great weight, size and strength, are required for bruising or grinding various substances; it is often difficult to procure stones of sufficient size and strength for these purposes; cast iron, though proper in point of strength, and easily made of almost any size or shape, is sometimes inconvenient from its weight, and is, for many purposes, too expensive. Instead of pure iron, the moulds in which such masses are to be cast should be nearly filled with stones, or, what would be still better, with bricks, as these could be easily moulded into the exact shape required; a proper space being left for an axle where needed, and an interstice between the outermost of them and the mould; melted iron should then be poured in to fill up every chink. This iron, cooling and consolidating, will unite or cement the stones or bricks firmly together, and cover them with an uniform surface of metal. Thus, masses of any size, shape, and weight, and of sufficient strength, may be procured at a cheap rate; as a very small quantity of metal would be sufficient for a cement and coating to the stones or bricks.

In the same way many architectural ornaments might be made very cheap and very durable; this method may be applied to the important purpose of bridge-building, where very large stones are often required for the construction of arches. Instead of such large stones, compound masses, such as those above described, might be applied, cemented with iron, and exactly moulded, so as to form, if required, an entire rib of an arch without a fissure; and in this way a number of arches might be accurately and firmly put together.—Dr. A.

METHOD OF MAKING THE TARTARS' KOUMISS WINE.

Take of fresh mare's milk of one day, any quantity; add to it a sixth part of water, and pour the mixture into a wooden vessel; use then, as a ferment, an eighth part of the sourest cow's milk that can be got; but, at any future preparation, a small portion of old *Koumiss* will better answer the purpose of souring; cover the vessel with a thick cloth, and set it in a place of moderate warmth; leave it at rest twenty-four hours, at the end of which time, the milk will have become sour, and a thick substance will be gathered on the top; then, with a stick, made at the lower end in the manner of a churn-staff, beat it, till the thick substance above mentioned be blended intimately with the subjacent fluid. In this situation, leave it again at rest for twenty-four hours more; after which, pour it into a higher and narrower vessel, resembling a churn, where the agitation must be repeated, as before, till the liquor appears to be perfectly homogeneous; and, in this state, it is called *Koumiss;* of which the taste ought to be a pleasant mixture of sweet and sour. Agitation must be employed every time before it is used. This process is varied in different places by the degree of heat and agitation, and the kind of ferment used.

When this liquor is employed medicinally, it is given at pleasure both as food and drink; and some cases have been briefly related, in which it proved highly restorative in emaciation, hectic, nervous debility, and incipient phthisis. From the success in these, it is recommended as an antiseptic, tonic, and restorative. —T. G.

PRINCIPAL DYES EMPLOYED BY THE NORTH AMERICAN INDIANS.

The *red* dye, used by the Indians, is a slender root called by them *Ha ta the caugh.* It is found to be madder, which grows naturally in their low swampy

grounds. They pound the roots in a mortar, with the addition of crab-juice, and then throw the mixture into a kettle of water, along with the substance to be dyed. By this process, they dye the white tails of deer, and porcupine quills, and can also give a beautiful red to wool.

Their *orange colour* is obtained from the root of the *Pocoon*, the outside being pared off; and also from the plant called *Touch-me-not*. The colour is fixed by the same acid of crabs.

Their *bright yellow* is dyed with the root of a plant growing spontaneously in the western woods. It is from one to three inches long, and half an inch in diameter, beset with a number of filaments. The root sends up a stalk about a foot high, at the top of which is one broad leaf. On the top of the leaf grows a red berry, in size and shape resembling a raspberry, but of a deeper red.

Their *green* is made by boiling various blue substances in the liquor of *Smooth-Hickery* bark, which dyes yellow. They dye their porcupine quills green by the water in which shreds of green cloth have been boiled.

Their *blues* are well known to be made by *Indigo*. It is to be observed that *Woad* is the natural produce of this country.

Black is dyed with *Sumach*. The Indians also make a beautiful black with the bark of the *White Walnut*, and a vegetable acid.

SCIENTIFIC INTELLIGENCE.

THE SCRAP GATHERER.

No. 35.—*Naturalizing Plants.*—Great attention has for some years been paid to the important subject of rendering plants of warm countries sufficiently hardy to enable them to sustain our variable climate. The most effectual way is to endeavour to bring such plants to ripen their seeds in the open air with as little assistance from glass as possible, and then to sow these seeds, from which a more hardy progeny may be expected. This mode, continued for several generations, may most probably naturalize the plant.

36.—*To facilitate the growth of Foreign Seeds.*—Mr. Humboldt has found, that seeds which do not commonly generate in our climate, or in our hot-houses, and which, of course, we cannot raise for our gardens, or hope to naturalize in our fields, become capable of germinating, when immersed for some days in a weak oxygenised muriatic acid. This interesting discovery has already turned to advantage in several botanic gardens.

37.—*To take impressions of Medals, Coins, &c.*—Cut fish-glue, or isinglass, into small pieces, immerse it in clear water, and set it on a slow fire; when gradually dissolved, let it boil slowly, stirring it with a wooden spoon, and taking off the scum. The liquor being sufficiently adhesive, take it off the fire; let it cool a little, and then pour it on the medal, or coin, you wish to copy, having first rubbed the coin over with oil. Let the composition lay about the thickness of a crown-piece on the medal. Then set it in a moderate air, neither too hot nor too cold, and let it cool and dry. When it is dry, it will loosen itself; you will find the impression correct, and the finest strokes expressed with the greatest accuracy. You may give a more pleasing effect to the composition, by mixing any colour with it—red, yellow, green, blue, &c.; and if you add a little parchment size to it, it will make it harder and better. This size is made by gently simmering the cuttings of clear white parchment in a pipkin, with a little water, till it becomes adhesive.

38.—*Cleaning Medals, &c.*—Professor Lancellotti, of Naples, in order to remove from ancient silver medals the rust that covers and often renders them illegible, first lays the medal in oxidated acid of salts, afterwards in a solution of sal-ammoniac for a short time, and then rubs it with a piece of linen cloth, until all the rust disappears.

39.—*Genuine Windsor Soap.*—To make this famous soap for washing the hands, shaving, &c., nothing more is necessary than to slice the best white soap as thin as possible, melt it in a stew-pan over a slow fire, scent it well with oil of caraway, and then pour it into a frame, or mould, made for that purpose, or a small drawer, adapted in size and form to the quantity. When it has stood three or four days in a dry situation, cut it into square pieces, and it is ready for use. By this simple mode, substituting any more favourite scent for that of caraway, all persons may suit themselves with a good perfumed

COOLING BEVERAGE.

SIR,—I observe in Number XXX. a Correspondent wishing to know what is the cheapest and safest beverage to drink in this hot weather. I think the following is a very safe, cheap, and nutritious beverage to drink, either within or without doors, at all times. One pound of British roasted corn, (white kind,) at 1s. per lb.; 36 English pints of good water, and from 12 to 14 pints of good milk; this being all boiled together for six minutes, as coffee is done, and then allowed to cool, will prove an excellent and cooling beverage; any quantity can be made in this proportion.

Your's, &c.

WM. WALKER.

Moffat, 6th August, 1824.

TO CLEAN PAPER.

To extract the marks of flies from paper, it is only necessary to soak the paper well in hot water; when this is thoroughly done, by applying a wet sponge, they will come clear off.—J. C.

ON ROASTING EGGS.

SIR,—An egg, the adage says, is "greim gun choimeas," i. e. the most substantial of morsels; and a toasted egg every body knows to be more salubrious and wholesome than a boiled one: nay, to some certain complaints—heart-burning, for instance—it proves a most efficacious thereapeutic. There are many, I have no doubt, who have tried to toast an egg, but who, for a very good reason, would not willingly repeat the experiment. Of this class I myself, indeed, would have been one, but for a discovery in itself very simple.

The first time I tried to toast an egg, I had the mortification not only to *hear* by report, but with my own eyes to *see* my *hopes* literally blasted! The cause of this disaster I leave your more Philosophical Correspondents to account for; my present purpose is to prescribe a preventive of such a disaster, which in brief is, just to break gently either end of the egg previous to putting it before the fire.—Your's, &c.

L. M. L.

LIST OF PATENTS.

March 20. For an instrument for finding the cubic contents of standing timber. To James Rogers, Marlborough.

March 20. For improvements on the bobbin-net lace machinery. To John Longford, Nottingham.

March 20. For improved machinery to spin cotton, wool, or silk. To John Heathcoat, Tiverton.

March 20. For a machine to make, from one piece of leather, without seam, shoes, gloves, caps, hats, sheaths, &c. To J. H. Petelpierre, Somers' Town.

March 22. For an apparatus for manufacturing and burning oil gas, communicated from abroad. To Charles Demeny, Fenchurch-Street, London.

NOTICES TO CORRESPONDENTS.

Communications from L. D. L., James Jones, J. L. &c. under consideration.—G. B. would oblige us by sending his address.—We have no doubt but the communications from W. B., Water of Leith, are very interesting and useful, but it will take some time to decipher them.—We shall endeavour to oblige David Aitken.—D. L. M.'s communication has been long prepared for publication, and an engraving has also been made for it, but we want a favourable opportunity for inserting it; we wish he would always keep the same signature.—L. M. L. is a wag, we wish he would study Mathematics, it might perhaps have the effect of Trophonius' cave upon him, as he stands much in need of it. We really can print no more of his "Advice to Bathers" than what follows:—"But, Sir, to avoid prolixity, allow me just to add, that, should any person ever find himself in so critical a situation, (as drowning,) let him, with all his might, beat the water downwards with his hands, in imitation of a dog. Whether, on such an occasion, he ought to use the feet, must depend upon the posture for the time being of the body, but this the person drowning will possibly find not easy to ascertain."—A Regular Purchaser will be attended to with pleasure.

ERRATUM.—In our last, page 40, col. 2, line 14, for *same* read *fifth*.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written. Original Patents, Inventions, &c. will be inserted on the shortest notice.

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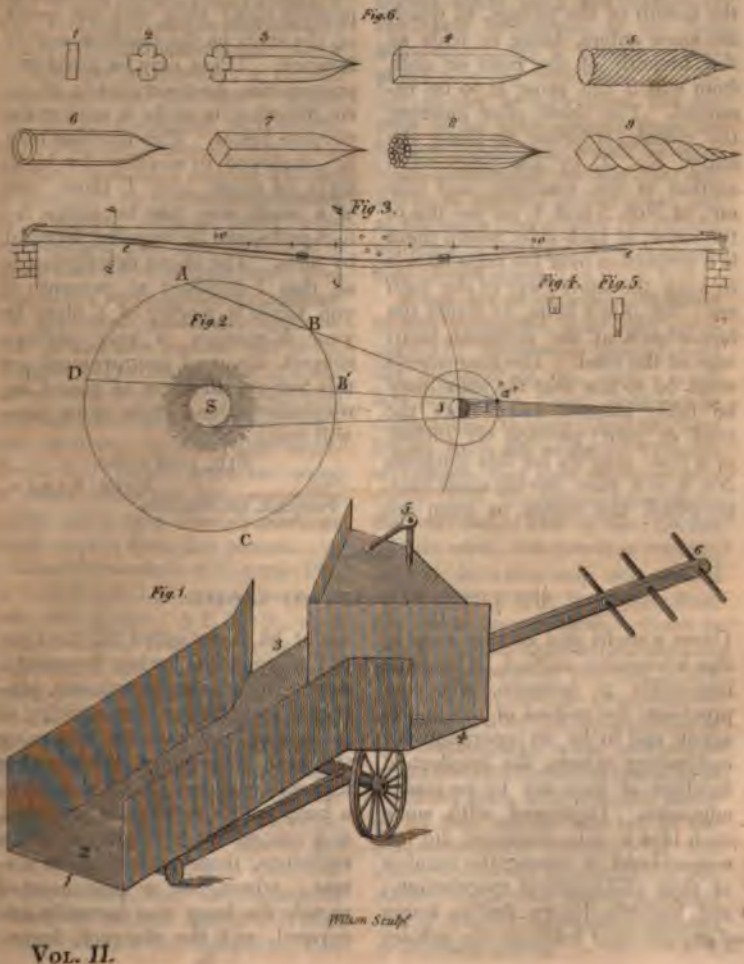
THE GLASGOW
MECHANICS' MAGAZINE.

"The true judges of the refinements of style, and embellishers of the temple of knowledge, know how the recesses of the brain are explored, and how deeply the mind must be searched, in obtaining the golden ore of poetry, and that not one pearl worthy of the king of science can see the sun, without diving a thousand times into the ocean of thought."—*Inatulla.*

No. XXXIV. *Saturday, 21st August,* 1824. Price 3*d.*

SNOW PLOUGH, SUSPENSION BRIDGE, GLASS, LIGHT, &c.



IMPROVED SNOW PLOUGH,

Invented by Mr. John Allan, Pennycuik, and presented at a Meeting of the Highland Society.

Sir,—Observing in your Magazine, No. XXII., Vol. I., page 351, a letter from a Correspondent wishing for a description of the Snow Plough given in by me to the Highland Society of Scotland, in compliance with that wish, I send you the enclosed drawing of it, with the following description: Fig.1, No.1, is the mouth of the plough, at which the snow enters, being as wide as the breadth of the road or path from which the snow is to be removed. The snow, after entering the mouth, is forced up along the entry, No. 2, by the progressive motion of the machine, and falls out, at Nos. 3 and 4, on the top of the snow, at each side, where there is a projection over the large wheels to keep the snow clear of the path cut; No. 5 is a helm, to direct the fore-wheels at the different turnings of the road. The fore wheels must be so low that the snow may be fairly cleared away from the road or path; perhaps six inches, or a foot, may do for this purpose. No. 6 is a pole, having cross bars, to which the horses or oxen are yoked, to impel the plough forward. The entry for the snow should be of the size of the road wanted to be cut, and the groove should rather widen along towards Nos. 3 and 4, that the snow may have more freedom to pass along. The hinder wheels are hid by the fore part of the work, so that in passing along they may not press on the snow as the machine moves forward. There may be great improvements, however, made on its construction, to make it answer the purpose better. This machine may be employed in clearing the highways of snow; and, I think, one of a small size may be made for foot-paths, and be impelled forward by men. The above description is all that I recollect at present; if you think it worthy of a place in your Magazine, it may perhaps suggest ideas of improvement on this subject to some of your Correspondents, and at the same time will much oblige,

Sir, your's, &c.

John Allan.

Pennycuik, 16th June, 1824.

ON THE VELOCITY OF LIGHT.

Upon a slight and cursory view of this interesting subject, it appears impossible to measure, with any precision, the motion of this subtle agent, and to be an operation for conducting which, the intellectual faculties of man are by no means adequate. Impressed with some such idea as this, mankind did not comprehend it among the number of their philosophical speculations; and, accordingly, we find no traces *of any attempt* whereby the subject might be investigated till the time of Galileo, who, having invented a nearly isochronous instrument, proposed ascertaining the rapidity of its motion, by directly observing the time it occupied in traversing a given distance. With this view, a lamp with a cover was provided, and carried by a coadjutor to an eminence, three or four miles distant; where, on a preconcerted signal, the lamp was instantly uncovered, and the observer, know-

ing the time of the emission of the ray, attempted to compare it with the time at which the light arrived at his eye. This experiment was, however, unsuccessful; no difference being perceived between the two periods of time: and hence philosophers adopted the notion of its instantaneous propagation—an idea not very clear nor well defined. But, analogous to the idea at present entertained of the motion of electricity in conducting vesicles, unsatisfactory though it was, this vague notion prevailed for nearly 70 years; when chance threw in the way of Roemer, a Danish astronomer, the fact which Galileo had in vain attempted to discover, as he was comparing the eclipses of the first satellite of Jupiter with the times given by the tables published by Cassini. These tables were constructed from observations of a great number of eclipses, and, consequently, were admirably adapted for the mean positions, distance, &c. of the two bodies. In 1672, Roemer began his scrutiny, and observed that it was only sometimes that the phenomena coincided with the tabulated account; that sometimes the eclipses were too soon, at other times too late, according as the earth was near Jupiter, or more remote from that planet.

Thus, in the annexed diagram: Fig. 2. Let S and J be respectively the Sun and Jupiter, A B C the orbit of the Earth, B and A being two positions of the Earth, distant from each other 60° = radius, and let "*a*" be a satellite entering Jupiter's shadow; then, if light be propagated without any sensible lapse of time, it would be seen eclipsed at the very same instant, by observers, whether at B or A. But it has been found, by an ample induction of particulars, that the immersion is seen $8\frac{1}{4}$ minutes sooner at B than at A; whence the *inference*, that light occupies this portion of time in being transmitted from B to A, and, consequently, $16\frac{1}{2}$ minutes in passing over the diameter of the Earth's orbit, or from B′ to D, supposing the line B′ D to pass through the centre of the orbit, or very near it.

This inequality cannot be supposed to arise from irregularities in the motion of the satellites themselves; for it happens to the whole of them, without relation to their position in their orbit, but connected solely with the position of the Earth, in relation to the Sun and Jupiter. It is therefore inexplicable by any legitimate irregularity in the Jovial system, but admits of an easy solution from the former hypothesis, which at once tends to establish the fact, that the Earth is moving in her orbit, and at the same time affords convincing evidence of the successive propagation of this *agent*.

From his experiments, Roemer at first concluded that light occupied $11\frac{1}{2}$ minutes in passing over the diameter of the Earth's orbit, but afterwards found occasion to correct that opinion; and we now know, from the mean of 100 observations, that light occupies precisely 493 seconds in describing the semi-major axis of the Earth's elliptic orbit; whence it is evident, that it occupies only one second and a fifth nearly, in passing from the Moon to our Earth. Such is the result so unexpectedly arrived at, by the exertions of Roemer, which was shortly after as unexpectedly corroborated by the observations of Dr. Bradley, who, while endeavouring to discover the annual parallax of the fixed stars, with a zenith sector of 24 feet radius, was led to the ever-memorable discovery of the aberration of the fixed stars—a discovery of the very first importance, and of which I shall give an account in a future paper.

D.

SUSPENSION BRIDGE,

Erected across the Ouse, Derbyshire, by Mr. Joseph Wrigley, Manchester.

Sir,—Having to-day received a copy of the Glasgow Mechanics' Magazine, No. XXII. Vol. I., which contains a drawing and description of the Suspension Bridge over the Kelvin, near Glasgow, I beg to state, that in 1817 I erected one a little different in construction, but on the same principle, across the river Ouse, on the estate of Thomas Winterbottom, Esq. of Fox Bank, Derbyshire, which gives great satisfaction. I do not, however, claim any merit in the construction, having copied it from the flooring of a wool mill in Yorkshire; this principle has been long acted upon in that neighbourhood for roofs and flooring beams. The insertion of the drawing and description which I herewith send you in your Magazine, will oblige,

Your constant reader,

Joseph Wrigley.

Manchester, 3d July, 1824.

The bridge is 48 feet 8 inches in span, and 9 feet wide; formed with four beams of red pine, each 15 inches deep, and 8 inches thick, with a circular rib of wood into which the bolt is bedded, 21 inches deep at the centre by 5 inches thick. This rib is bolted to the beam by a cast iron plate at the centre, also by iron dowls as shown in Fig. 3, which is a section of the beam to show the manner of fixing the bolt, which is 1¼ inch thick of best chain cable iron in three pieces joined by coupling. The bolts enter the beam at *e e*, and pass out near its upper end through a cast iron socket on the end of the beam, and are tightened by screw nuts as shown in the figure. A thin facing of wood is nailed above the bolt on the rib, which prevents it from being seen when finished.

Fig. 4 is a cross section of the beam by the line *a b*, and Fig. 5, the same by the line *c d*. Two iron bolts pass across under the flooring for binding the beams together, as shown at *o o*, Fig. 3.

[This description was accompanied by another drawing, representing a front view of the bridge, but it was so very similar in appearance to the one formerly given in No. XXII. Vol. I., that we considered an engraving of it as unnecessary, especially as all the difference between it and the former can be easily understood from the figures we have given. We trust our Correspondent will be satisfied with this explanation, not only as a reason for the omission of the drawing, but also for the delay in its publication, our object being to combine as much as possible, novelty with utility.

Mr. Wrigley's plan appears to have an advantage over Mr. Herbertson's, in its being more free of elasticity, and, consequently, more steady and firm under the feet of the passenger; on the other hand, it appears to be less applicable to bridges of very great span than Mr. Herbertson's plan, which seems capable of being carried to any extent.]

ON THE MODE OF PROCURING PATENTS.

A writ, in the King's name, and under the great seal, securing, for a *limited term, to an inventor*, the sole right to make and sell the material product of an invention, is called "Letters Patent;" hence the

term Patent is applied to the right thus conveyed. New manufactures are the first object of this exclusive privilege. By the statute, a manufacture is construed to mean a vendible substance, either in the form of an engine or material; the one the result of mechanical, the other of chemical skill. The manufacture ought to be *useful*, though this is not mentioned in the statute: the inventor, however, makes affidavit to this effect. It must also be *adequate* to produce the professed effect, otherwise the patent is void. A philosophical principle, not embodied in a mechanical or chemical result, or a mere process, unless it produces a vendible substance, cannot be protected by patent. It is, nevertheless, a common error to entitle a patent—"a method" of producing certain effects, though the effect produced is all that is meant. The noblest of all mechanical inventions, the steam engine, is an example of the inapplicableness of a patent to a mere principle. The principle discovered was the expansive force of steam; but the patent only protects the *machine* called the steam engine.

The manufacture must be "new within the realm:" this entitles either the original inventor or the importer of a foreign invention, however old, to a patent right. To constitute a new invention, it is requisite that it be a compound; either, 1st, a new arrangement of common or elementary substances—although, in chemical language, they may be called compound; or, 2d, a new arrangement of substances already mechanically or chemically arranged; or, 3d, an improvement, by adding to a previous mechanical or chemical arrangement; or, lastly, a new method or process of manufacturing articles already in common use, by which they may be produced in greater abundance, perfection, or cheapness.

The first requisite is infringed by adopting a different form of arrangement, or a different material, even in cases where these are not essential to the principle of the patent. This point is, therefore, usually guarded in a patent, by specifying a certain material and form, and adding the words—"or any others more suitable." With respect to the second, if the invention is a new arrangement of one or more old combinations, not patented, either with one another or with other substances, it may become patent right. If the old combinations newly arranged are patented, the new patentee cannot manufacture his invention without the license of the previous patentee; but if the former alters the principle of any of these patent arrangements, it becomes his own.

With regard to the third requisite, it may be observed that a variation of the principle is not considered as an improvement, but as a new invention. An improvement is founded on the previous arrangement of the materials, and the patent secures the right to the improvement only. An instance occurred in which a patent was taken out for an improved movement in a watch, which was rendered void by being taken out for the whole watch. Many examples might be given of the fourth, such as a new process for refining sugar, bleaching linen, &c. which are all proper objects of patent right. The utmost caution is necessary on the part of an inventor to preserve his secret till the patent is sealed, otherwise he may be involved in legal disputes, and ultimately lose his right. He must also be sole inventor, as a hint from another has often proved fatal to a patent.

When an inventor intends to apply for a patent, he ought to lodge what is called a "caveat" at the offices of the Attorney and Solicitor General, desiring a notice of all patents for which application has been made for the same or a similar invention. This caveat, which ought to be broadly stated, is of importance to those who may be engaged in a series of difficult and expensive experiments, but who may not have brought their invention to a sufficient state of maturity to render an application for a patent necessary; to those who have applied for a patent, which has not yet passed the great seal; and to those who possess patents; that they may oppose all subsequent applications for patents for the same invention. This is all the use that can be made of a caveat. When the person who lodges the caveat, receives notice from the Attorney or Solicitor General of an application for the same or a similar invention, he must appear in person, or by proxy, and lay his invention before these officers, with evidence, if necessary, of its date, progress, &c. The same is done by the other applicant for the patent. Each case is considered separately and privately, and the question of priority or difference decided, according as the inventions are the same or different from each other. If they be different, both the inventors are entitled to a patent, but if neither point can be determined, a joint patent is generally recommended.

The inventor having completed his invention, applies to the King by petition, accompanied by an affidavit, sworn before a Master in Chancery, or a Magistrate in the country, setting forth that he is the first and sole inventor; that his invention will be of public benefit; and that it has never been in previous use to the best of his belief. This petition is referred by the King to his Attorney and Solicitor General, when an opposition to the caveat, if any, takes place; if there be no opposition, or if it has been met and defeated, the invention is then reported to be worthy of a patent. The report is always made, as a matter of course, when there is no opposition, and in such cases contains the following distinct qualification: "as it is entirely at the hazard of the said petitioner whether the said invention is new, or will have the desired success." A Bill, prepared as a warrant, and signed with the sign manual, after several official steps, authorizes the letters patent to be made out at the Lord Chancellor's office, *where the right is secured by affixing the great seal.* The invention must now be fully disclosed to the public, by the law, within one month, or, more generally in practice, within two months after the patent is sealed, in a writing sworn to, signed and sealed by the inventor, containing a complete description thereof, with an account of the mode of operation of the different parts, and the union of the whole, so clear, that the patent article may be made or constructed from that description alone, by any person engaged in the same kind of manufacture, or acquainted with mechanics or chemistry in general. This description, which is called the "specification" of the patent, and may be accompanied, though not necessarily, by drawings or models of the invention, is the last step in the proceedings, and is essential for ascertaining and limiting the patent right. It is then enrolled, and any person applying is entitled to have a copy, on paying the office fees. Though the public can neither make nor use the invention for fourteen years, without the licence of the patentee, yet the publication of the

specification is useful, to show others engaged in similar inventions how far they have been anticipated, that they may thereby save their labour, and avoid unintentional piracy. The right acquired by the letters patent and specification is a vested right, descendable to the patentee's heirs, or transferable to assignees; not exceeding five individuals without an especial Act of Parliament. A patent cannot be granted to more than five persons, nor the term of fourteen years prolonged, except by the same means.

Separate and distinct letters patent must also be taken out for the three kingdoms, and pass under the three great seals, to prevent encroachment upon the right in any part of the empire; and they may be extended to the colonies by a trifling additional expense. The procedure for procuring them in England and Ireland is the same, but in Scotland it is different. The application for a patent must be remitted to the Lord Advocate, who reports on it; the great seal is affixed by the authority of the keeper, and the specification is enrolled in the chancery office. Mistakes in the specification render the patent void; what those mistakes are, which prove fatal to a patent, will be considered in a future Number.

AN ACCOUNT of several circumstances connected with the DUCTILITY of GLASS.—By JOHN DEUCHAR, Esq. M. R. A. I. Edinburgh; M. W. S.; F. R. P. S.; and Lecturer on Chemistry and Experimental Philosophy in Edinburgh.

(*Read before the Wernerian Natural History Society, on 18th May*, 1822.)

THE great ductility of glass seems, at an early period of the history of that compound, to have been noticed by philosophers; but they have entirely overlooked several very important accompanying circumstances. They had, in the construction of the thermometer and other instruments, found that a hollow ball could be drawn out till it formed a very long tube still hollow; but they made no attempts to ascertain the extent to which the ductility of a tube might be carried, without the hollow part being closed up, nor if it were at all changed in its relative dimensions. Thus their knowledge of the ductility of hollow glass appears to have been confined to the observation, that a melted tube, drawn out by the fingers till it formed very brittle threads, still admitted of the air being blown through it.

But, with regard to solid glass, no experiments whatever seem, at that early period, to have been tried to ascertain its ductility. This attempt was left for modern ingenuity; at first, about forty or fifty years ago, it was performed by means of the fingers; and the late Mr. Knee, of Edinburgh, was the only person who did so to any great extent. A mode, however, was introduced about twenty years afterwards, by means of which the glass was drawn out upon a wheel with greater rapidity than common threads. This method of spinning glass, as it is now termed, was exhibited in Scotland, by Mr. Gheri, in 1808; by Mr. Finn, in 1811; and by Mr. Davidson, in 1812; and I have availed myself of their assistance in drawing such of the specimens of spun glass, noticed in the present experiments, as are not of my own manufacture.

I was led to examine the subject from the different appearance I observed in the threads drawn from a piece of window-glass with sharp angles, and those drawn from a cir-

cular piece of crystal equally transparent; the former having great lustre, and the latter presenting a dull surface.

Although thirteen years have now elapsed since I commenced the investigation, during eight of which I have been in the practice of showing the experiments in my classes, yet no treatise upon glass, so far as my information goes, has thrown out any hint on the subject; on which account I have been induced to lay the present facts before the Society. It would be tedious and unnecessary to occupy the time of the Society in giving an account of the whole of the numerous experiments in which I have been engaged; I shall therefore select a few of the more striking.

Experiment 1. Some of the hollow glass threads were put into distilled water, and then placed under the receiver of an air-pump; upon the air being withdrawn from the receiver, bubbles of air issued from the ends of the glass threads, and continued to do so, as long as the exhaustion was kept up.

Experiment 2. In another experiment, twenty grains of glass thread, drawn from a tube, fig. 6, were kept at the bottom of a jar of mercury, under the receiver of an air-pump, and the air was withdrawn; the glass was weighed after the experiment, and found to have increased to more than twice its former weight, from the mercury which then occupied the space from which the air had escaped. The hollow threads were more brittle than the solid.

Experiment 3. Another experiment may be selected, which shows the result in a more striking point of view: a piece of thermometer tube, the bore of which was very small, was drawn into threads remarkably fine. The wheel, round which the threads were spun, had a circumference of three feet, and this, making 500 revolutions in a minute, proved that 30,000 yards of the glass had been drawn round it in an hour; and as the state of fusion and quantity fused at a time of the glass is the same, whether the drawing be rapid or slow, it follows, that in this example the thread must have been very fine, and its bore almost incalculably minute. Some of this thread was cut into pieces an inch and a half long, and these so situated on the top of the receiver of an air-pump, that the one end of each tube communicated with the interior, and the other with the exterior of the receiver; to make the result still more satisfactory, a few of the threads had their under ends bent out from the rest; mercury was then poured over the upper ends of the glass threads, and the air thereafter exhausted from the receiver; upon which being done, the mercury was seen entering the receiver through the minute tubes, and falling in drops from them.

The effect of this minute ductility was next tried with regard to glass rods of different shapes, which led to very curious results; specimens of which I beg now to lay before the Society, and to the most particular of these I shall take the liberty of directing their attention.

1st. The first specimen was drawn from a narrow piece of window-glass, cut with a diamond, and of course presenting very sharp angles; shown in Fig. 6, Nos. 1 and 4. This thread, when examined with a powerful microscope, was found to present a flatted oblong appearance, with four well worked right angles, No. 1. It is very likely that this peculiar shape is the cause of the superior lustre of the specimens of thread drawn from window-glass; the round crystal rod always gives a dull appearance, and the lustre brightens

as the specimens assume more an angular form. No. 7 is a square piece of crystal, the threads square.

2d. The next specimen was drawn from a twisted piece of square glass, No. 9. When examined with the glass, the thread was found to be square, but had lost the twisted appearance of the original.

3d. The next specimen was drawn from a piece of fluted crystal, presenting four grooves, Nos. 2 and 3. The fluted appearance is most distinctly retained by the spun glass, when placed before the microscope, No. 2.

4th. The last specimen I shall notice was drawn from a twisted piece of grooved glass, see No. 5. The threads retain the same form, but from the number of the grooves, a powerful glass is required to examine it. The spun glass appears to have the grooves straight.*

From these examples, and from more than fifty others which have been tried, it is proved that glass has the singular property of retaining its shape, although brought to the fluid state, and although drawn into threads at that high temperature; and, if the external form remain unchanged, we are entitled to conclude that the internal form and arrangement will follow the same law.

Some experiments were next tried by combining glass, of different colours, into one rod, and then spinning it out into threads as before, see No. 8. The thread was always found to retain all the colours of the original rod unchanged, and did not present the smallest appearance of a break-off in any of the colours, or of the slightest intermixture; sometimes two, three, and even ten shades of colour were employed at once.

These circumstances may open up an extensive field for investigation, to those philosophers who delight in speculations regarding the ultimate atoms of bodies, and their peculiar shape. In the whole of these examples of ductility, we find that the atoms of the glass have a tendency to retain their original form, although its magnitude be diminished; the square, the oblong, the circular, the fluted, and hollow rods, were still in the soft and silky threads to which they were spun, of the same shape as at first. Can the shape of the atoms, or any modification of the power of attraction, give rise to this? It is evident that the same portion which occupies the angles of the large piece of window-glass will be extended over the angles of the spun threads; and the same is illustrated, in another point of view, by the many coloured glass rod, the shades of which retained their order and distinctive character.

The last experiments were with glass rods of different colours; the most of the colours appeared to have faded by the operation, particularly the yellow, which in some trials was nearly gone; the black became brown, and the purple and green were somewhat altered; the blue seemed to suffer no change. The white glass, coloured with arsenic, gave very brittle threads.

Most of these specimens of spun glass are remarkably soft, like silk, and can be easily rolled up in the manner of common thread, and platted into ornaments. To the feel, they resemble the hair of the head; that spun from black glass has often been mistaken for brown hair; it resembles the hair in another respect, for it retains the curls communicated to it by rolling it round a hot iron.

Note.—Since the above paper was read before the Wernerian Natural His-

* These experiments were performed before the Society.

tory Society, I have been able, with the assistance of the ingenious Mr. Lovi of Edinburgh, by means of an improved wheel, to draw about 1950 yards of the glass thread in one minute: I have not, however, yet examined any of this very fine specimen through the microscope.

[We were not, at first, aware that this paper was originally published in the Annals of Philosophy for November, 1822, page 358; this accounts for the prominent situation in which we have placed it. We are always glad to receive *any* communications from our Correspondents, though we prefer those that are *original*.]

ON LAMP GLASSES.

Sir,—I observe "A Sufferer," in your last No. wishes to know why the glass chimnies of lamps sometimes "rend asunder, when neither heat nor external force are applied to them:" I shall therefore attempt to point out the cause and the remedy. Glass is a very bad conductor of heat; in consequence of which, one part of its surface is often made to expand before the heat can pass through it to the rest, and, as the glass is not elastic, a crack must follow. But, besides this, there is a curious character possessed by glass, and a few other vitreous bodies, of having the state of tension of their particles, if not their polarity, altered by sudden changes of temperature, which causes them to fall to pieces when acted upon by the slightest vibration or change in the degree of heat. The ingenuity of the manufacturer, has enabled him to remove this property of glass, by means of a process called annealing. This is effected by cooling the glass slowly from the high temperature at which it is formed. By annealing, the glass acquires a toughness, which enables us to use it for philosophic and domestic purposes, within a moderate range of temperature; but, when exposed to rather high temperatures, the glass so far returns to the un-annealed state, and resumes its tendency to fall to pieces from the slight vibration or change of temperature to which it may be exposed.

It is easy to apply these facts to the query of "A Sufferer."—The high temperature to which the heat of the gas raises the glass chimnies, partially removes the annealing, and the rapid cooling leaves them very brittle. The remedy, however, is as obvious as the cause; all we have to do is to put the flame gradually out, and thus we allow the glass to cool slowly, and, in fact, repeat the process of annealing.

It is remarkable how slight a vibration is sometimes sufficient to break an un-annealed crystal vessel, especially when it is thick; if a glass chimney be placed upon the floor, at one end of a room, the vibration communicated to it by a person walking across the same piece of wood, at the other end of the room, is often sufficient to cause it to fall to pieces; or, if the glass chimney be put near an open door, the current of air entering sometimes produces the same result.

I remain, Sir, your's, &c.

John Deuchar.

Edinburgh, 18th August, 1824.

MECHANICAL GEOGRAPHY.

Extent of the Counties of Scotland; ascertained by Mr. Jardine *and* Sir George Stewart Mackenzie.

In order to ascertain, with as much precision as possible, the superficies of Scotland, and of the different counties, a copy of Arrowsmith's map was selected, the

paper of which was nearly of uniform thickness. A portion of each sheet, equal to 5000 English square miles, measured from the scale of the map, was carefully weighed; the balance used in this, and the subsequent operations, being sensible to $\frac{1}{100}$th part of a grain, when loaded with 2 lbs. in each scale. Each county was then accurately separated by means of a sharp-pointed knife, and its weight compared with that of the portion of the sheet to which it belonged. In those counties which contained a considerable portion of *fresh* water lakes, the lakes were also separated and compared in a similar manner; and, from these data, the surfaces of the land and water of each county were deduced.—The map of Scotland constructed by Arrowsmith, is undoubtedly the best that has hitherto been published. It does contain a few errors in the positions of places, and a few in the courses of the rivers; but none have yet been discovered that can affect the present calculation in any material degree. Indeed, if Arrowsmith took greater pains to render one part of his map more interesting than another, it was in ascertaining the boundaries of counties; and, in doing this, he was liberally assisted by the Parliamentary Commissioners for Highland Roads and Bridges. On the whole, the following Table may be regarded as the nearest approximation to the truth hitherto attempted. The method employed seems to have been first made use of by Dr. Long of Cambridge, in 1742, to ascertain the proportion of the land to the water, on the surface of the earth. It must be observed, that from a recent comparison, made with great accuracy, of the Scotch standard ell, and the English standard yard, it appears that the Scotch chain should be, at the temperature of 60° of Fahrenheit, 74.1234 English feet, instead of 74.4, the length of the chain in common use. In the calculations by which the Table has been constructed, the correct length was used, which makes a difference of above 11,000 Scotch acres, to be added to what the sum would have been, had the common measures been employed.

Counties.		English Acres.
Aberdeen,		1,238,080
Argyll,	Mainland,	1,415,898
	Islands,	502,816
	Water,	20,554
Ayr,		666,886
Banff,		404,864
Berwick,		306,253
Bute,		98,547
Caithness,	Land,	472,186
	Water,	4,128
Clackmannan,		33,632
Cromarty,	Land,	162,451
	Water,	5,485
Dumfries,		813,696
Dumbarton,	Land,	157,549
	Water,	20,826
Edinburgh,		247,994
Elgin,		302,093
Fife,		333,724
Forfar,		625,901
Haddington,		186,214
Inverness,	Mainland,	1,745,056
	Islands,	662,400
	Water,	53,626
Kincardine,		256,582
Kinross,	Land,	49,325
	Water,	4,326
Kirkudbright,		521,286
Lanark,		635,910
Linlithgow,		85,933
Nairn,		125,856
Orkney Islands,	Land,	200,800
	Water,	5,856
Shetland Islands,		330,637
Peebles,		222,144
Perth,	Land,	1,811,392
	Water,	21,491
Renfrew,		148,794
Ross,	Mainland,	1,301,747
	Islands,	359,149
	Water,	25,229
Roxburgh,		464,518
Selkirk,		170,182
Stirling,		340,691
Sutherland,	Land,	1,193,939
	Water,	24,230
Wigton,		283,379
Total,	Land,	19,078,502
	Water,*	185,751

* Water, *i. e.* Lochs or Lakes only.

ON PROGNOSTIC SIGNS OF THE WEATHER.

There are scarcely any subjects in which mankind feel themselves more interested than in a knowledge of the weather, the temperature of the air, and the influences of wind and rain; this truth is sufficiently evident, from the circumstance

that these subjects constantly form the principal topics of their conversation. The traveller endeavours to regulate his motions, and the farmer his operations, by the state of the weather; and, in short, by a good or a bad season, as an instrumental cause, plenty or famine is dispensed, and millions are furnished with, or deprived of, the necessaries of life.

Notwithstanding its importance, our actual knowledge of the atmosphere is blended with much uncertainty, and, in many instances, enveloped in obscurity, yet enough is even now known to enable us to obviate danger, and avoid inconvenience. The speculative philosopher contemplates with pleasure the changes in the weather, changes that present the mind with some of the most wonderful among natural effects, all working with boundless variety for the good of the world and its inhabitants.

Among the various considerations that tend to mortify human pride, and humble its arrogance, there is perhaps none more striking than the reflection, that the most brilliant labours of men are seldom the most useful, but, on the contrary, are often detrimental, both to the present and future generations; yet these are admired, while the humble labours of those by whom science is advanced, and civilization gradually diffused, are looked upon with equal contempt by the slave of ambition and the man of genius.

It is, however, only by the assiduous observation, and the patient investigation of the constitution of the air, and of the variations in the weight of the atmosphere, and by forming a regular history of the winds, of the rain, and of the changes of heat and cold, that we can ever expect to discover the connection of those phenomena in the atmosphere, which now appear to be unconnected and without order. Furnished with these data, we might perhaps be enabled to follow the course, and predict the changes of the elements with as much certainty as we now do those of the planetary bodies.

If every one who is in possession of meteorological instruments would keep a diurnal register of the state and of the corresponding phenomena of the atmosphere, and transmit the result of his observations to the public through the *current channel*, he would contribute more to the advancement of this branch of science than he might at first imagine. While he was amusing himself and only gratifying his own curiosity, he would be promoting knowledge, and probably procuring benefits for posterity. Let no one suffer the apparent improbability of success to discourage him from the attempt. Let him remember that science advances only by slow and gradual steps, that its progress depends on the cultivation of the mind, the removal of obstacles, and the exertions of individuals; that the present is ever pregnant with the future, but that the connections between them can only be discovered by long attention and diligent observation.

Meteorological phenomena, like all the durable motions of the world, depend upon a circulation of matter. Here, it is carried on by a changing of water into a new form, and a regeneration of it into its primitive form; it goes off from the surface of the earth in the form of a rare, invisible, expanded vapour, perfectly dissolved in the air as a menstruum; being suspended for some time in this state, it is afterwards condensed into mist and clouds, then gathered into drops, when it falls; and, in this form, it returns to the place from whence it came, to take its turn once more in the common course of evaporation, and be again and again circulated to the great promptuary of the world.

The state of the atmosphere is influenced and modified by the variations in its density or weight, by the quantity of aqueous particles, by the visible collection of them in clouds, by their precipitation in rain, by the wind, by the agency of electricity, and the action of heat and cold.

There is no part of Meteorology which interests mankind so much as the predictions which it furnishes of the change of the weather. The theory of this science only engages the attention, by animating us with the hopes of thereby bringing the knowledge of these predictions to perfection. And the far greater part of those who purchase meteorological instruments, purchase them, not so much to know the actual state of the elements, as to foresee and foretell the changes about to take place in them. This science is, however, very imperfect; it is but of late years that observations on the changes of the weather have been made; that its progress has been rapid and successful, may be seen in the works of De Luc, De Saussure, Jones, Marshall, and Kirwan. But these observa-

tions will be still more valuable to posterity, for we can scarce expect them in number sufficient in our own age, to deduce from them a general and perfect theory.

To attain this end, it will be necessary to multiply observations on as great a number of *signs* as possible, for it is only by their combination and concurrence that we can expect to remove the uncertainty inseparable from each in itself. Thus, the barometer is not always a certain sign; the same may be said of the thermometer, the hygrometer, and the action of winds. But if they all concur together, there is little chance of being deceived, and there would be still less, if to these were joined other *signs*, which are easy to observe, and which, by their combination, would render our prediction certain.

No sign, nor any instrument of observation, [should be rejected,] either from a love of ideal perfection, or fears of inaccuracy; thus, though the hygrometer be at present a very imperfect instrument, yet some signs have been obtained from its indications, and more may be reasonably expected; even the words, 'very dry,' 'very moist,' 'moderately dry,' 'moderately moist,' though of vague determination, may throw much light on the state of the atmosphere.

It is necessary that the observer should enter into a precise detail of the various states of the sky and the clouds; such as the transparency of the air, the dews, the elevation, form, disposition, colour, and density of the clouds, things that may be observed with ease, and described without trouble; being attended with no other inconvenience than that of extending the size of our meteorological tables.

D. A. N.

(To be continued.)

NOMENCLATURE OF THE CLOUDS.

1. *Cirrus.* Parallel, flexuous, or diverging fibres, extensible in any or in all directions.

2. *Cumulus.* Convex or conical heaps, increasing upwards from a horizontal base.

3. *Stratus.* A widely extended, continuous, horizontal sheet, increasing from below.

4. *Cirro-cumulus.* Small, well-defined, roundish masses, in close horizontal arrangement.

5. *Cirro-stratus.* Horizontal or slightly inclined masses, attenuated towards a part or the whole of their circumference, bent downwards or undulated, separate or in groups, consisting of small clouds having these characters.

6. *Cumulo-stratus.* The cirro-stratus blended with the cumulus, and either appearing intermixed with the heaps of the latter, or superadding a wide spread structure to its base.

7. *Cumulo-cirro-stratus,* or *Nimbus.* The rain-cloud. A horizontal sheet above, which the cirrus spreads, while cumulus enters it laterally and from beneath.—*Thomson's An. Phil.*

VARIOUS COMMUNICATIONS.

ON ARCHITECTURE.

Sir,—The general adoption of the Gothic style of architecture for buildings of almost every description, to the exclusion of the Grecian and Roman styles, has, in our days of classical feelings and tastes, created regret in the minds of amateurs. That we should at the same time cultivate with so much assiduity the pure attic style in literature, and discard, or forget, that no less pure style of architecture, is an anomaly which seems difficult to be reconciled. These remarks are chiefly, however, if not solely applicable to those buildings in the neighbourhood of our city, comprehending a circle of perhaps 20 or 30 miles radius; for, in the city itself, the modern Grecian style has the pre-eminence over every other, both in public edifices and private houses. In the neighbourhood of the city, on the contrary, there are few buildings erected in any other style than either the Sacred or the Castellated Gothic. What the advantages are which are gained by this style, I am at a loss to discover. It certainly imparts no additional conveniences to any building, and as to the comforts, they are out of the question. That it imparts an elegant appearance to a man-

sion, will even admit of doubt. On the summit of some beetling crag, or in the midst of some black and stumped heath, there is certainly more of the *Feudal* look in the Castellated Gothic than in the Grecian style. But in the midst of well cultivated fields, bordering a beautiful river, or on a gently rising eminence, overlooking rich pasture grounds, is there any style of building which so well accords with their pastoral appearance, loaded, as they are, with the bounty of Pomona, or groaning under the weight of a thousand sheaves, than the pure Attica, rich in symmetry and elegance. The former appears sombre and heavy, frowning in all the barbarity of Vandalism, a momento as it were of the savage ideas that gave it birth, disproportioned and irregular, (for I hold that *proportion* is no part of the order;) the latter appears chaste and elegant; the eye wanders over it, unable to discover a defect, either in its most minute details, or most extensive proportions; nothing seems to be superfluous, and nothing that could be spared. To deprive it of any, even of the smallest of its members, or to make the most trifling addition to its parts, would destroy the beautiful harmony that reigns through the whole; in fine, it is plain, yet elegant and chaste, symmetrical, yet magnificent; and let me add, calculated both for comfort and convenience.

In drawing this comparison, I take for my specimens of both styles of architecture, those edifices which remain as the models for the artists of our day to imitate; but how sadly they mutilate and disfigure both, may be seen by any who choose to give themselves the least trouble to examine. Indeed, the present style of Gothic architecture is no more like that of the middle ages, (which this age pretends is their model,) than the building on the site of the Old Jail is like St. Paul's in London, or St. Peter's at Rome. There is neither regularity nor proportion in the old Castellated Gothic style; but among the artists of our day there is every effort made to produce both.

The style at present adopted for the adornment of this city, cannot, by any means, be defended from the animadversions of those, who, like myself, would prefer the purer styles of ancient Greece. The last public edifice is, I am sorry to say, on the authority of a worthy and able townsman, a striking example of the want of unity, not in the design, but in the ornaments. I mean the New Court Houses and Jail. No blame, I understand, can be attached to the architect, whose plan and designs did not embrace those parts, which, instead of being ornaments, tend only to disfigure the general elegance of the building. The exceptionable parts, to which I allude, are the Roman Lictor Rods, and Laurel Crowns, which do not look well upon a building of Grecian Doric.*

As a contrast to this, I gladly recur to the gradual improvements that are taking place in the style of several buildings in the western part of the city; and when we consider the size and the utility of buildings, and the crowded state in which they must necessarily be placed in a street, where uniformity must give place to individual caprice, we may express a hope that those artists, whose tastes have been so strikingly displayed in them and other buildings of the same kind in this city, will, in the end, accomplish what every man of taste in his profession would, I doubt not, wish to see realized—the total abandonment of the Gothic, and the substitution of the Grecian, in all public or private buildings, whether in town or country.

Your's, truly,

N. P.

Partick, August 1, 1824.

USEFUL HINTS.

Sir,—It is rather singular, when we see Lecturers getting up on almost every art, and in almost every large city in the kingdom, that (so far as I know) no one has attempted a Course of Lectures on Nautical Affairs. A greater field for cultivation is not to be found in any art in this country. It is only within these few years that Government has taken the hint to form a Gallery of Ship Models at Sommerset Town.

Our agriculture is nearly in the same state, if we except what Sir Humphrey Davy has done. Without agriculture we could not thrive well in any art. It is certainly a loss to the country that we

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* What the Royal Arms was intended to signify, I leave to Lord Lyon, King-at-Arms; as for the City Arms, the tree seems to have been scathed by lightning, and the salmon spoiled by carriage from the Tay—the Clyde never contained a fish to which it bears any resemblance.

have not a Lecturer and a Gallery of Agricultural Models. If it does no good at the present day, it might do good to generations yet to come.

The other day, in passing by a stone quarry, my attention was attracted by the method of working the stone. In Asia, they work the stone something similar, but with this exception: When the loose earth is cleared away, they get a quantity of brush-wood and set fire to it. There can be no doubt, but heat loosens the stratum; the seams run from four to three feet. I am certain the people in Asia do more work in the same time than is done in this country, though the people here have more muscular strength than they have.

Did ever any one of your readers, or Correspondents, make whisky from barley newly cut, without having been dried either in the field or barn? As this is the time for an experiment of this kind, if any one choose to try it, I hope he will have the goodness to give you the result of it. There is no doubt but the Government can collect the duty in the one way as well as the other, it would only be a new thing to all.

C. D.

HOW TO WALK ON WATER.

SIR,—I ask leave to propose an ingenious plan like Mr. Kent's, for walking on the surface of the water. Furnish yourself with two rods of iron, 8 or 12 feet long. Place at the distance of 12 inches from the top of the rods, a float, either of cork, or an air vessel, of such a buoyancy, that it will support a rod and half a man's body—I mean a rod finished, and half the weight of a man besides. Now, place a counterpoise at the bottom of each rod, to preserve your centre of gravity, and have the rods secured by straps, or otherwise at a certain distance from each other. Fasten your feet, while in a standing position, to the tops of the rods. Attach to the rods some kind of fins, fixed neither perpendicularly nor horizontally, but between the two, so that, when you lean forward to step, they will expand and give you a purchase, and when you *draw* your foot after you, they will collapse and offer no resistance to the water. The pieces of the rods above water are to be made fast to your legs by straps below the knee. By such simple means you may traverse the water safely, cross ferries, rescue the drowning, and accomplish many other feats, which it is impossible to do on land.

I am, Sir, your's,

JAMES JONES.

Edinburgh, 15th August, 1824.

FACTS RESPECTING THE POTATOE.

IT is a curious fact in the history of the vegetable kingdom, that the potatoe, *Solanum Tuberosum* of Linnæus, the native of a warm climate, should be naturalized and extensively cultivated in our northern regions, on account of its valuable properties, as an essential article of human food.

It is no less curious to trace the progress which this plant made, before it was received into general use; the precise period of the introduction of this root into this country is not distinctly ascertained; however, it is generally believed that it was first brought into Europe by Sir Walter Raleigh,* and nursed, with great care, by a gardener at Hammersmith; from thence it was carried into Holland as a curious exotic. Some years after it was propagated in Flanders and the northern parts of France, where it was first used in Europe as food for the vulgar. While it was spreading daily, an epidemic disease arose in France which proved very mortal. The physicians declared that it was occasioned by the use of the potatoe; in consequence of which, Arrets of Parliament were issued against it. When thus unjustly proscribed by medical skill and civil power, it was no longer used as common food, but was cultivated by the curious and ate by the unbelieving. In this state it travelled through France and Italy, from which last country it was brought back to England as an useful vegetable. It was, however, little eaten in London for a long time; but from Bristol it went into Ireland, and by the skirts of Wales into Lancashire, where it was cultivated to great perfection. About the beginning of last century the people in Ireland sent it in small quantities to their friends in Glasgow, who distributed it in plates, as we do apples. Shortly after it was planted in Kintyre, from whence it travelled gradually through Scotland, while it at

* The same enterprising gentleman who first introduced the use of tobacco into this country.

the same time made its way into the different counties of England. It again crossed the German ocean, and has made such progress that it is now raised in the most northern countries of Europe. The diversity of soil, situation and culture, to which the potatoe has been subject, has given rise to numerous varieties, which are chiefly characterised by the quality of the root, quantity of produce, and period of ripening. All the varieties have been included under two divisions, distinguished by the colour of the flower and the root; as, the red-rooted, which produces a purple flower; and the white-rooted, which bears a white flower. New varieties are obtained by raising it from seed, by which the quality and productive powers of the plant may be greatly improved.—J. T.

ASTRONOMICAL QUERY.

"A Sceptic" asks the reason why "the stars can be best seen from the bottom of a deep pit?" as he thinks, that they ought to be better seen from the top of a mountain.

MECHANICAL QUERY.

"A Gallowgate Inquirer" wishes to know who was the inventor of the crane, and at what period it first made its appearance? as he was informed "that it was first brought into use in Glasgow by the lectures of that celebrated man Dr. Birkbeck."

AIR ARCHITECTURE.

A Correspondent, J. W., has repeatedly sent us the following query: "Can a hanging stair be hung backwards—that is, beginning at the top and building downwards?" We would ask him, what is the use of such a plan, if it could be adopted? Is it not easier to begin at the bottom, since the space there must be occupied at last?

SCIENTIFIC INTELLIGENCE.

New and Useful Invention.—William Hollins, a resident of Baltimore, has constructed the model of a vessel, called a "Safety Ark," for which he has taken out letters patent for the United States. The object of this invention is to enable the arks, boats, &c. which descend the Susquehanna, (after passing through the present canal, at Port Deposit,) to reach Baltimore in twelve hours, a distance of 60 miles, with their entire cargoes on board, to be towed by a steam boat.

It is said it will also answer to convey the canal boats, in perfect safety, without transshipping at Albany, to the City of New-York, and return them again to the canal fully loaded.

Many of the citizens of Baltimore have already pronounced it to be a perfect floating canal.

Galvanism.—If a piece of tin-foil be laid on the point of the tongue, and the rounded end of a silver pencil-case be placed against the ball of the eye, while the other end rests on the tinfoil, a pale flash of light will diffuse itself over the whole of the eye. If the experiment is made with zinc and gold instead of tin-foil and silver, the flash is incomparably more vivid. By placing one of the metals as high up as possible between the gums and the upper lip, and the other in a similar situation with regard to the under lip, a flash will be produced as vivid as that occasioned in the former instance, with this remarkable difference, that the flash produced, instead of being confined to the eye, will be diffused over the whole face.

NOTICES TO CORRESPONDENTS.

Communications from J. F., James Jones, A. B. Dollar, J. R. Gallowgate, under consideration.—L. M'L. and "The Scrap Gatherer" are postponed till next week.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written. Original Patents, Inventions, &c. will be inserted on the shortest notice.

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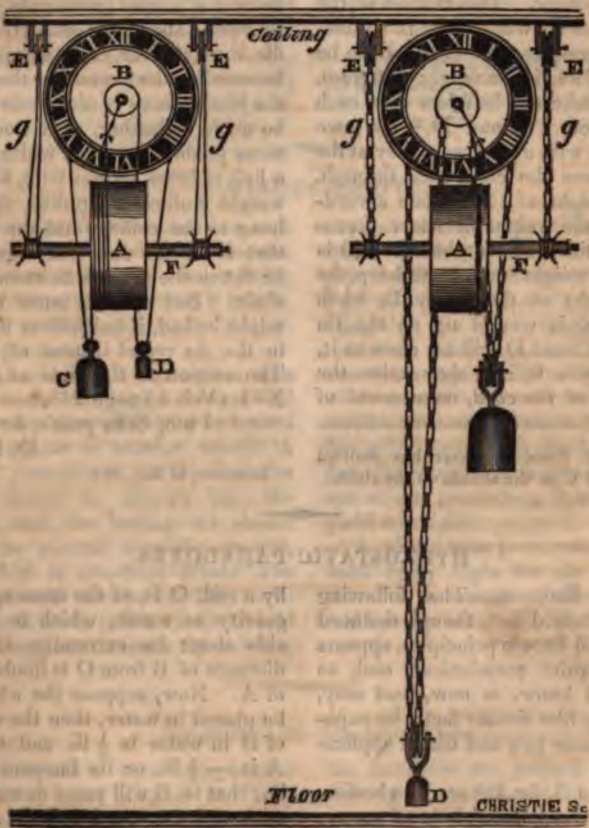
THE GLASGOW MECHANICS' MAGAZINE.

"Hail, Memory, hail! in thy exhaustless mine
From age to age unnumber'd treasures shine!
Thought and her shadowy brood thy call obey,
And Place and Time are subject to thy sway!
Thy pleasures most we feel, when most alone;
The only pleasures we can call our own.
Lighter than air, Hope's Summer-visions die,
If but a fleeting cloud obscure the sky;
If but a beam of sober Reason play,
Lo, Fancy's fairy frost-work melts away!
But can the wiles of Art, the grasp of Power,
Snatch the rich relics of a well-spent hour?"—*Rogers.*

No. XXXV. *Saturday, 28th August,* 1824. Price 3*d.*

IMPROVEMENT ON THE CLEPSYDRA.



IMPROVED CLEPSYDRA.

Mr. Editor,—I was much delighted at the different accounts you gave of water-clocks in No. XVI. (Vol. I.) of your Magazine, and I was much pleased with the one that "An Observer" sent you, which you say has one objection, namely, that it requires frequent winding up. I hereby send you two sketches of an improvement that I have made, by which the clock will go about four or five times longer without winding up; and the higher the ceiling is, it will go the longer. The motion of the tin vessel A, will require to be one-half slower, and the pulley B, to be one-half less in diameter; therefore, it will take one-half less cord each revolution. C and D * are two weights with a grooved pulley at the top where the cord goes through. The weight of C is made according to the weight of water that is in the tin vessel for balance; D is a small weight merely to keep the cord tight on the pulley B; when the cord is wound up on the tin vessel, C and D will be close to it, and while falling they take the double of the cord, on account of the ends of the cord being fastened at the dial. E E are two grooved pullies hung to the ceiling, and the spindle F is suspended from them by the cords *g g*, and when the tin vessel goes round, of course they are all put in motion, the spindle F is left square at one end, for winding up with a handle, and on the ends of the spindle there are two grooves, in the form of a screw, which the cord goes round to keep it from sliding. But perhaps it might be better to have a small chain instead of a cord, with nobs on the tin vessel, and on the end of the spindle F, to answer each link, as will be seen by the sketch on the right; the black places of the chain might be made of leather, as it would be more pliable, the small white places a link of brass or iron wire, and the weight pullies, the pullies that are hung to the ceiling, and the pulley that is on the dial, will require to be flat in the groove, to answer the chain. But a much surer motion might be had, if quicksilver was put in the tin vessel instead of water. The section is the same as in No. XVI. (Vol. I.) page 248.

I am, Sir, your's, &c.

D. L. M'.

Johnstone, 3d May, 1824.

* Our Wood-Engraver has omitted the letter C in the sketch on the right.

HYDROSTATIC PARADOXES.

Mr. Editor,—The following Hydrostatical fact, though deduced from well known principles, appears to be quite paradoxical; and, so far as I know, is new, and may, perhaps, like similar facts, be capable of some new and useful application.

A and B, fig. 1,* are two bodies, each of the bulk of 1 lb. of water; the weight of B is $1\frac{1}{2}$ lb. and that of A is $\frac{1}{4}$ lb.; they are connected by a rod, O B, of the same specific gravity as water, which is moveable about its extremity, O; the distance of B from O is double that of A. Now, suppose the whole to be placed in water, then the weight of B in water is $\frac{1}{2}$ lb. and that of A is — $\frac{3}{4}$ lb. or its buoyancy is $\frac{3}{4}$ lb.; that is, B will press downwards with a force equal to $\frac{1}{2}$ lb. and A will press upwards with a force equal to $\frac{3}{4}$ lb. But B being at

double the distance of A from the centre of motion O, its proportional effect will be $\frac{1}{2} \times 2 = 1$, while that of A is only $\frac{3}{4} \times 1$; therefore the pressure of B will preponderate, and O A B will descend to the vertical position O V. Now, the weight of a quantity of water equal in bulk to A and B is 2 lbs. while that of A and B is only $1\frac{3}{4}$ lb.; so that the whole body O A B is lighter than its bulk of water, and yet it descends in water. In a similar manner it might be shown that the bodies C and D may be heavier than their bulk of water, and so arranged that they would ascend to the vertical position O L.

In fig. 6, No. XXXII., Vol. II., the water pump has a valve at F, as in the common pump.

Explanation of the paradox, Vol. II., page 42.

THE pressure of the water in every direction at any point B, fig.2,* being equal, if E B and F B be the directions of two of these pressures equally inclined to the radius produced O B G, then their resultant is G B O, in the direction of the centre; which can, therefore, have no tendency to put the wheel in motion. The same may be said of every two similar pressures, hence, the wheel remains in equilibrium.

A. B.

Dollar, 14th August, 1824.

* These figures are unavoidably deferred till next Number.

LUMINOUS BOTTLE.

IT is easy to prepare a bottle which shall give sufficient light during the night to admit of the hour being easily seen on the dial of a watch, as well as other objects, by the following means.

A phial of clear white glass, of a long form, should be chosen, and some fine olive oil should be heated to ebullition in another vessel: A bit of phosphorus, of the size of a pea, should be thrown into the phial, and the boiling oil should then be poured carefully over it, the phial is one-third filled: The phial should then be carefully corked; and, when it is used, it should be unstopped, to admit the external air, and closed again: The empty space of the phial will then appear luminous, and give as much light as a dull ordinary lamp. Each time that the light disappears, on removing the stopper it will instantly re-appear. It is proper to observe, that in cold weather it will be necessary to warm the bottle for a little while in the hands before the stopper is removed, without which precaution it would not yield any light.

A phial, thus prepared, may be used every night for six months: there is no danger of fire from it, and its cost is very small.

P. I.

NUMBERING OF HOUSES.

A NEW mode of numbering houses has long been adopted at Paris, which is attended with much advantage, and deserves to be followed *in this country.* Over each door the numbers are painted in large distinct characters, and in conspicuous colours; they are generally either brown or red, on a yellow ground, surrounded by a blue square; but

the principal singularity, which is the object of this notice, is, that all the odd numbers are placed on one side of the street, and the even numbers on the other; by which means, may be seen at once, on entering the street, at which side of the way the house is, which is sought for; by this mode much time may be saved in two ways; first, it is unnecessary ever to cross the street more than once; second, the trouble of returning back again on the other side of the street from that already passed, to find a particular number is always prevented; a circumstance which often happens, where the old method of numbering is used, owing to the order of the numbers proceeding regularly down one side of the street, and back again in the reversed direction, on the other; this, when the streets are very long, as is generally the case in large towns, is often attended with serious inconvenience; but, when this new method of numbering is adopted, this can never occur, as the numbers proceed in the order of progression in the same direction at both sides of the street.

P. I.

ON THE POWER PRODUCED BY ANIMAL STRENGTH.

The effort employed to produce action on machines by the strength of animals in general, and of men in particular, is the result either of muscular force, the weight of the body, or the combination of both. In whatever manner the effort is produced, there is a combination of three elements in the result, which it is of importance properly to distinguish:—first, the mode of action, consisting either of pressure or traction; second, the speed imparted by the action; and, third, the duration of the action, which depends on the fatigue experienced by the moving agent.

The effort is either momentary or continued. If it is momentary, the short duration of the action allows the agent to give to the other two elements all the intensity of which they are susceptible. If it is continued, that is, prolonged during a whole day, then these elements are necessarily modified by the duration of the action, and the continued effort, in the same circumstances, the time being equal, is always less than the momentary effort. The relation between the two efforts varies in different cases; but experience seems to indicate that the continued effort is commonly about a third part of the momentary.

The pressure or traction, the speed, and the duration of the action, may in every case have an infinity of relative and different values. But all the combinations of these values are not equally advantageous; there must exist one among them which gives the greatest possible effect, and which is therefore called *a maximum*. Theory, without experience, is insufficient to determine this maximum; and experience, in this case, and in all those which relate to a continued effort, can only be of real utility, and can only give positive results, if the following has been strictly observed:—1st, if the effort is directly applied to the machines themselves, or on the mechanical organs whose effect we wish to determine; 2d, if it continued regularly during several complete periods of daily labour; 3d, if several individuals of similar strength are successively employed; and, 4th, if the labour has been conscientiously inspected, with all possible attention and assi-

duity. To these may be added a fifth, of equal importance, namely —that several machines of the same kind be employed, on each of which these experiments may be renewed.

This experimental method is, no doubt, long and expensive: it requires uncommon perseverance, but it is this alone which can effectually contribute to the perfection of this important branch of mechanics, which, though deprived of positive data, is in a state of imperfection that calls strongly for the attention of those philosophers who are desirous of rendering their labours useful to society.

Man, employed as a mechanical agent, produces action in two different ways: first, by remaining always in the same place; and, second, by locomotion. He operates, in the first way, when he draws or pushes vertically either upwards or downwards, and when being seated, or having his body supported against a fixture, he draws or pushes horizontally and obliquely, by the application of the muscular force of his arms or legs.

There are two kinds of pressures or tractions, absolute and relative. The first excludes velocity, and produces only a sort of equilibrium; it is that, which, in every mode of action, is the greatest that an individual can exert; it is that which is indicated by the dynamometer, when the person who makes trial of his strength, by means of this instrument, concentrates all his force on the machine. The second, or what is relative, combines with velocity, and is modified by it; its amount, being always less than that of the former, or what is absolute, is in the inverse proportion of the degrees of the velocity imparted by the agent.

When a man, without changing his place, draws or pushes, either in a vertical direction upwards or downwards, or in a horizontal or oblique direction downwards, he acts by the muscular force of his arms; and, as in these four kinds of action, the operating cause is the same, we conclude that the resulting effect is the same in equal circumstances. The weight of the body co-operates with the action in tractions, that is, in pulling vertically downwards, horizontally, or obliquely; but this co-operation neither increases nor diminishes the effect produced by the muscular force alone; for it is evident that the weight which acts must be sustained by an equivalent portion of the muscular force, and that this portion then ceases to contribute directly to the traction. Thus, in the four cases mentioned, the pressure or traction depends entirely on the muscular force; it is that which produces it, and it is that which maintains it; the weight of the body possesses only an inert force, which owes to the muscular force all its moving power.

PHILO-MECHANICUS.

(To be continued.)

ON ROTATIVE MOTION IN STEAM ENGINES.

MR. EDITOR,—The direct application of steam power to machinery, for the purpose of effecting a rotative motion, is a desideratum that has engaged much attention, and many attempts have been made to accomplish it. By attaining this object, the steam engine would be relieved from a cumbersome load of matter with which it is now burdened, as intermediates, to convert the vertical into the rotative motion.

It has been estimated that an

engine whose cylinder is 54 inches in diameter, requires a walking-beam of three tons and a half, moving with a velocity of three feet in a second; and this weight must be twice brought from rest and put into motion to furnish one double stroke; this reduces the power of the engine considerably, so much so, that Mr. Watt could not load his engines when the walking-beam was of sufficient strength, with more than eleven pounds on the inch, and retain motion to make fifteen six-feet strokes in a minute. It is evident, then, if we divest the engine of the intermediate machinery, there would be a saving of power, room, fuel, walking-beam, parallel motion, fly-wheel, crank, &c.

In No. X. of your useful and amusing work, the Glasgow Mechanics' Magazine, you have given a description and engraving of a rotative steam engine, manufactured by Messrs. Job Rider and Co. Belfast, for which a patent has been obtained. I am no practical mechanic, nor engaged in business of the kind, yet I sometimes amuse myself with matters of this description. My attention was, consequently, directed to investigate the design and mechanism of this engine, and although I am much pleased with the ingenuity displayed in its construction, yet I am inclined to think that, in its present state, it is too complicated and liable to be deranged in the multiplicity of its moveable parts, ever to come into general use or competition with those engines constructed on Mr. Watt's plan. This induced me to attempt the simplification of this engine, and endeavour to curtail those parts which I consider redundancies.

I intended to have corresponded with you on this subject some time ago, but delayed in consequence of seeing in your notices to Correspondents that you would soon lay before your readers an improved plan of this engine, which is now given in Number XXVII. This scheme of improvement I find differs essentially from mine; for, instead of reducing the moveable parts of the engine, J. W. has added two sliding wypers or valves, and another eduction valve; and this, we are told, is for the purpose of taking steam from the cylinder to heat the cabin of the boat, wherever the engine is placed, and to augment the force of the air-pump. If steam is used for this purpose, I should prefer taking it from the eduction pipe by connecting with hollow pillars in the cabin through which the steam had to pass before it reached the condenser; this would save all the steam that J. W. proposes to take from the cylinder to heat the cabin; and, instead of expending the steam on minor objects, I would shut it off when the piston or valve had performed one-fourth of its rotation. Its expansive force would then be exerted on the work that the engine had to perform, the cabin would be heated without waste of steam or additional machinery, and the force of the air-pump would be no more diminished, nor more water to condense the steam required, in this way than in the mode that J. W. proposes. He also states, that he would have the piece of brass in Messrs. J. Rider & Co.'s engine taken away. If, by the piece of brass, he means the steam obstructor betwixt the steam and eduction pipes, I cannot understand how the engine will move at all. If he would condescend to elucidate these matters, his plan would be more comprehensible. The simplification that I propose is, to do away with the six sliding wypers, or valves, in Messrs. Rider & Co.'s engine, and the eight in J. W.'s, and substitute

two folding valves, which would receive the whole impulse of the steam alternately during the time of their rotation. If the sliding wyper, acted on by a spring, is preferred to the folding valves, two of them I submit, will produce a rotative motion with better effect than eight.

Z.

P. S.—Since writing the above, I have devised another plan of a rotative steam engine, in which there is neither folding valve, spring wyper, nor eccentric motion. If the plan of an engine of this description is wanted, I will either commune or correspond with any of your readers on the subject.—Z.

ON PROGNOSTIC SIGNS OF THE WEATHER.

(Continued from page 77, Vol. II.)

THERE is a phenomenon which has not been sufficiently attended to, namely, the undulating motion of the air, which is kept up by the heat of the sun. What the sun raises from the earth, by the heat of the day, is sustained in the atmosphere by its heat, and the agitation or expansive undulation of the air. This motion is quite visible to the naked eye, but in the field of a powerful telescope it is very conspicuous, all objects appear in violent agitation, and the line of the sensible horizon which ought to be clear and well defined, is waved like a field of corn in the wind, or the surface of the sea after a storm. So long as this agitation continues, the vapours stay in the air; but when it subsides, and the sun departs, they are condensed, and fall down to the earth in the night as a dew.

In the present state of this part of science, unacquainted as we are with so many phenomena, and still more ignorant of their causes, general rules will often be found to fail, and particular ones will, without much circumspection, prove to be a source of error. Among the variety of means for predicting the changes of the weather, the Barometer is undoubtedly one of the best, and is, in this, as well as many other respects, one of the greatest acquisitions to natural philosophy.

The usual ranges of the mercurial column in this latitude, are comprised between 28 and 31 inches, of which the middle, or 29½, is considered as the variable. I think it should be placed somewhat higher; near the pole, the variations of the Barometer are much greater; between the tropics much less.

Prognostics from the Barometer.

In general when the Barometer falls, the air being lighter, will let fall its vapour and give us rain. But when the mercury rises, the air being heavier, will support the vapours and be productive of fine weather. If the mercury falls in a frost, we may expect snow or a thaw; but if it rises in winter with a north or east wind, it generally portends a frost.

In order, however, to deduce any observations with certainty, we must attend to the progress of the rise or fall; thus, if it sinks slowly and gradually, we may expect that the rain will be of some continuance; but if the rise be gradual, we may judge that the fine weather will be lasting.

If the Barometer fluctuates much, rising and falling suddenly, the weather is unsettled and changeable.

If it falls *very* low, there will be much rain; but if its fall be low and sudden, a high wind generally ensues.

When *exceeding* low, storms and tempestuous weather may be expected; but if an *extraordinary* fall happens, without any remarkable change near at hand, it is probable that there is a storm at no great distance.

The descent of the Barometer is not, however, always an indication of rain, for it will often fall for wind; nor is its rise a certain sign of fair weather, particularly if the wind be northerly or easterly.

If the fine weather be lasting, with a westerly wind, the Barometer generally rests a little above changeable, but somewhat below 30 inches.

In the summer months, the Barometer does not vary so much as in winter; the greatest variations are in the two first, and the two last months of the year, viz. November, December, January, and February, but particularly in December and January. A north-east wind generally makes the Barometer in this

country rise, and it is generally lowest with a south-westerly wind.

From Beighton's Rules.

If the mercury continues to fall while it rains, it will likely rain the next day.

When the mercury is pretty high, and has fallen to foretell rain, and yet rises before the rain falls, it is an indication that there will be but little of it.

In serene and hot weather, when the mercury is high and rising, and you have all possible certainty of fair weather the next day, and yet there should happen to fall very heavy showers, it is probable they have been driven upon you by the effect of distant thunder.

In fair weather, when the mercury has continued high and rising, if it falls about noon, and rises again towards the evening, a single shower may be expected on the evening or noon of the next day, and then fair weather.

When the mercury rises gradually about half-a-tenth, and continues to do so for many days, the fair weather may be expected to continue for some time, unless wind intervenes, particularly from the S. W. by S.

From the Barometer and Thermometer.

If the air, in foggy weather, becomes hotter by the action of the sun alone, the fog generally dissipates, and the air remains serene; but if the Barometer falls, and the change of temperature be from a south or south west wind, the fog rises and forms itself into clouds, and its ascension is generally a sign of rain.

From the Barometer, Hygrometer, wind, and state of the sky.

The Barometer being high and stationary, the Hygrometer indicating dry air, the canopy of the sky lofty, and the wind north easterly, are the surest signs of settled fair; while a light and moist atmosphere, the canopy of the sky low, and a south west wind, certainly portend a wet season.

From the Thermometer.

In winter, if the cold diminishes suddenly, it in general portends rain; in summer, a sudden augmentation of heat is also a fore-runner of rain.

From the Hygrometer and Thermometer.

It is, in most cases, a certain sign of fair weather when the march of the Hygrometer, from its greatest extreme of humidity in the morning to the greatest degree of dryness in the afternoon, is greater than it generally makes, with the same temperature, while the reverse is one of the most certain indications of rain.

Prognostics from the clouds.

There are so many ways by which it is supposed we may foretell the approaching weather, that Virgil was bold enough to affirm, that no shower ever did damage to any man without giving him proper warning; among these, the signs from the clouds are many and important, for from the clouds the rain proceeds, and it is the state of the air, with respect to the water they contain, that either prevents or hastens its fall into rain.

The formation and solution of clouds in the sky are often manifest to the sight, if they are watched attentively for some time together; particularly in a summer's evening, we shall see them lessen by degrees, and be at last so totally dissolved in the air, as to be no longer visible. This re-solution of the clouds into air, and their disappearance from the sight, may be considered as a strong symptom of fair weather.

But, on the other hand, when they are collected out of it, and manifestly increase, both in density and magnitude, it is a strong prognostic of rain. Thus, when the sky has been long serene and blue, becomes fretted and spotted with innumerable small clouds, bearing some resemblance to the waves of the sea, or the party-coloured back of a mackerel; at first they are thin, white, and fleecy; but by degrees grow dark and black, and are in general generated at about the height of three quarters of a mile from the earth.

Against heavy rain, every cloud rises bigger than the preceding, and all are in a growing state; this is most remarkable on the approach of a thunder storm, when small fragments of clouds increase and assemble together till in a short space of time they cover the sky.

When the clouds are formed like fleeces, deep and dense toward the middle, and very white at the edges, with a bright blue sky about them, they generally soon fall in hail, snow, or in hasty showers of rain.

If clouds are seen to breed high in the air, in thin white trains, like locks of wool, or the tails of horses, they show

that the vapour is spread and scattered by contrary winds above, while it is collecting; from which, wind will soon be produced below, and probably rain with it.

If the clouds, as they come forward, seem to diverge from a point in the horizon, a wind may be expected from *that* or the opposite quarter.

When a general cloudiness covers the sky above, and there are small black fragments of clouds like smoke flying underneath, rain is seldom far off, and is generally lasting.

There is no sign of rain more certain than two different currents of clouds, especially if the undermost flies fast before the wind; two such currents in hot weather portend a thunder storm.

(To be concluded in our next.)

HOW TO CHOOSE A SCIENTIFIC LECTURER.

"Give me a pin to stick in my thumb,
To carry my Lady to London Town;
London Town 's a bonny place,
All spread o'er with gold and lace."

Auntient Babye Rhymes.

We have always scouted an opinion entertained by many, that at this advanced period of knowledge, there is any subject which is not reducible to first principles. But, as it has been universally admitted by rhetoricians, that the consideration of a particular instance has more effect, than any general reasoning, however clear and however eloquent, we purpose, on the present occasion, to show the truth of our general maxim, by presenting our readers with a philosophical view of the self-evident principles on which men proceed in choosing a Scientific Lecturer.

I. Of the Person.

1. He must be old, for a very evident reason—he will be fond of good old-fashioned notions. No doubt it may be said that additional investigations can only render old notions more stable. But this is evidently contrary to the first principle we have laid down, and therefore absurd. Another ground upon which we think the lecturer should be old, is, that in this case he will not be troubled with that ardour and enthusiasm which belong to youth, but which are quite unnecessary in a lecturer, who, by these qualities, is prevented from occasionally affording his hearers the recreation of a gentle nap; an enjoyment admitted, on all hands, to be one of the most refreshing in nature.

2. He must be as little known as possible. This principle proceeds on the universally admitted truth, that there is no man (that any body is acquainted with) who has not faults and imperfections. Now, since it is certainly desirable that we should get a lecturer without faults and imperfections, it clearly follows, that, in order to get such a person, we must look out for one we know nothing about.

3. In subservience to the preceding principle, is the following essential one: That the lecturer should come from a distance, and especially from London, Paris, Rome, or Constantinople. The best proof of the correctness of any general maxim is the extensive footing which it is found to maintain among men of sense. Now, among such men, what maxim is, or can be, more prevalent than the one we have just laid down? All hats made in Glasgow, (to take a common instance,) are marked LONDON, which every body knows produces so essential an improvement on their quality, that, without it, they would not be saleable. Who has not heard of the eminent titles—

PERRUQUIER FROM LONDON,

TAILOR FROM LONDON,
CHIMNEY-SWEEPER FROM LONDON,
MILLINER AND DRESS-MAKER FROM LONDON?

After an enumeration so splendid, what head of correct judgment, or what heart of genuine feeling, would accept any but a LECTURER FROM LONDON; or could, without disgust, think of a GLASGOW LECTURER for Glasgow? Besides, who does not know that Glasgow enjoys the reputation of being quite above the low pursuits of Science and Literature? It is manifestly, therefore, impossible to choose a Glasgow Lecturer, without impeaching, in these respects, the character of our sweet native—our poor dear—our poor uninformed—poor innocent—GLASGOW—that never said harm to nobody—no, never—never!—

Whose tree never grew,
Whose bell never rang,
Whose bird never flew,
Whose fish never swam!

II. Of the Persons who recommend a Lecturer.

1. and 2. The two last principles respecting a lecturer apply equally to those by whom he may be recommended. *First*, it is quite unnecessary that they be known, except, of course, vaguely. *Secondly*, it is desireable that they should live at as great a distance as possible. In addition to the considerations we have already stated under these heads, there is the following: If the persons who recommend a lecturer were on the spot, it is clear that they would implicate their own characters in giving him favourable testimonials. Hence, since favourable testimonials must be had, we justly prefer those from a distance.

3. It is quite unnecessary that those who give testimonials should, by profession, or otherwise, be acquainted with those sciences to which they recommend others as fit for lecturers. It is on this ground, that His Royal Highness the Commander-in-Chief, His Grace the Archbishop of Canterbury, the Right Honourable the Lord Chancellor, not forgetting the Reverend the Moderator of the General Assembly of the Church of Scotland, are universally admitted to be the best possible sources from which a lecturer can obtain testimonials of his abilities in the departments of Anatomy and Surgery!

III. Of Titles.

Finally, We proceed to make one or two observations on the subject of TITLES, so indispensable both to the lecturer and to those by whom he is recommended. We need not say how entirely out of the question it is for any lecturer, who is not amply *titled*, to expect success in any application he makes. There, now, were our eminent friend, Mr. A Brainless, to apply for a lectureship on Craniology, either to our old friends of the Andersonian Institution, or to our numerous friends of the Glasgow Mechanics' Institution, but, by mischance, omit giving his title, would his application be entertained? No! not for a moment. But let him only add his title:

TESTIMONIALS
IN FAVOUR OF
A BRAINLESS A S S,

and, after this, could any sensible man doubt his capacity for lecturing on Craniology?

Fee! fa! fum!
We smell the blood of an Englishman;
Be he living, or be he dead,
We'll grind his bones to make our bread!!

SCIENTIFIC INTELLIGENCE.

ILLUMINATING POWERS AND COMPARATIVE DENSITIES OF GAS FROM COAL AND OIL.

[*The following copy of a letter from Professor* LESLIE, *to the Directors of the Edinburgh Gas Light Company, will be interesting to our friends occupied in such researches as relate to the comparative merits of these two Gases.*]

Edinburgh, 19th July, 1824.

GENTLEMEN,—The various discrepant accounts, and the confident assertions, repeated, I suspect, without due examination, concerning the relative advantages of the Coal and the Oil Gas, made me desirous of instituting an enquiry into the subject, with more precise and accurate means of investigation than had been generally employed. Your invitation last winter to make experiments on this important subject, prompted me to defer this research no longer; but as I projected several changes and modifications in the instruments to be used, I could not conveniently commence the operations till within these few weeks. I am now engaged in the prosecution of an extensive series of such experiments, which promise all the information that could be desired.

Though I have had time to explore a part only of the subject, yet the results, however different from the common averments, are consistent and satisfactory, and may be deemed important. I therefore think it right to make a report *at this stage of the inquiry*, but shall confine my remarks to two points: 1st, The comparative Density of the Gases; and 2d, Their relative Powers of Illumination.

First.—The Density of your Coal Gas commonly does not much exceed *six-tenths* of that of atmospheric air. When I began the operations, its density was only .593; but it was afterwards .618, and is now .623. In winter I once found it to be .680, and at another time as high as .700, though it was oftener at .600. The variation seldom, I presume, exceeds the *eighth* part.

A small quantity of Oil Gas, procured for the Experiments, I found to have the specific gravity of only .674, not greater indeed than that of your Coal-Gas, when made from the best Coal. The Oil Gas, however, furnished by Mr. Milne, manufactured on a small scale, and apparently with great care, at his Works, was materially denser, being as high as .943, though on a former occasion I found it to be only .810.

If we assume in round numbers the density of Coal and Oil Gas to be six and nine tenths of that of atmospheric air, it is easy to compute, that, under the pressure of half an inch of water the quantities discharged from the burner No. I. of the Oil-Gas, which contains ten holes, each having the $\frac{1}{40}$ of an inch in diameter, would be respectively $4\frac{3}{4}$ and $3\frac{5}{8}$ cubic feet. The quantities actually consumed, however, are only about the halves of those measures, because the aperture is always contracted by partly shutting the cock to bring the flame to the same standard height. When the flame is thus regulated, I find the consumption of the same Gas, and with the same burner, always the same, whatever may be the load placed on the Gasometer. For instance, after increasing the load four times, and consequently doubling the velocity of discharge, yet on adjusting the cock so as to reduce the flame to its former height, the expenditure of the Gas was not altered.

Second.—The Illuminating Powers of the two Gases were *measured* with great accuracy, by the application of my Photometer, which I had somewhat modified to exclude every irregular influence of heat. The indications were steady and easily noted, nor could the judgment of the observer be liable, as in other cases, to any sort of bias or indecision. It hence appears to be ascertained, that with the same burner the powers of illumination of different Gases, and of the same Gas in different states, are very nearly proportional to their densities. The same *weight* of Gas of any kind gives out the same quantity of light; but if equal *bulks* be taken, the illuminating powers follow the ratio of their densities. But the quantity of light emitted is not uniformly proportional to the measure of the Gas expended. A certain burner, for instance, was observed to produce double the illuminating effect, though it consumed only one-half more of either species of Gas. With No. 1 of the Oil Gas burner, the relative illumination of Mr. Milne's Oil Gas to that of your Coal Gas, was found to be as six to five. But a cubic foot of the former lasted thirty-eight minutes, while a cubic foot of the Coal Gas was spent in thirty

minutes and a half. The relative volumes consumed were hence in the space of an hour 1.58 and 1.97, or in the ratio of four to five. Wherefore, while five cubic feet of Coal Gas give five degrees of light, four cubic feet of the best Oil Gas give six degrees; that is, for equal volumes the illuminating power of the Oil to the Coal Gas is as *three* to *two*. The same conclusion was obtained on passing those several Gases successively through the argand Coal Gas burner, No. 2.

Thus the illumination of Oil Gas is actually less than the half of what has been currently asserted.

I have the honour to be,
GENTLEMEN,
Your most obedt. Servant,
JOHN LESLIE.

From the ratio of illuminating power, which Professor Leslie has thus found to subsist between Oil and Coal Gas, it follows that 1000 cubic feet of the former are equal to 1500 cubic feet of the latter, giving out the same quantity of light, and being in every respect equal in value.

The Lowest Price at which Oil Gas has yet been sold is 40s. per 1000 cubic feet, and that of Coal Gas in Edinburgh is 12s. per 1000 cubic feet.

	£	s.	d.
Thus the price of 1000 cubic feet of Oil Gas is............	£2	0	0
And the price of 1500 cubic feet of Coal Gas (affording the same degree of light) is	0	18	0
Hence, there is a saving, by the use of Coal Gas, of.....	£1	2	0

Or, in other words, the same quantity of light which, when produced from Oil Gas, will cost £20, will only cost £9 when produced from Coal Gas.

THE SCRAP GATHERER.

No. 41.—*To make Salt Water Fresh.*—The distillation of palatable and fresh water at sea has been effected by P. Nicole of Dieppe, by simply causing the steam arising from boiling sea-water, in a still, to pass through a stratum of coarsely-powdered charcoal, in its way to the condenser, or worm-tube.

42. *Chinese method of mending China.*—Take a piece of flint-glass, beat it to a fine powder, and grind it well with the white of an egg, when it will join china in such a way that no art can break it in the same place, and without having recourse to the dangerous method of rivetting. It is to be observed, that the composition must be ground extremely fine on a painter's stone.

HIGHEST MOUNTAIN IN EUROPE.

TWO very recent travellers, Zumstein and Vincent, who appear to have been the first individuals that ever ascended Monte Rosa, ascertained that its highest summit is 15,600 Paris feet (16,629 English feet) above the level of the sea. Hence it cannot be doubted, *that the highest point of Monte Rosa exceeds considerably that of Mont Blanc;* and that we cannot dispute the claim of the former to be the highest mountain in Europe, since the latter, according to Professor Tralles, is only 14,793 Paris feet (15,768 English feet) above the level of the sea.

Electricity produced by Congelation of Water.—When water is frozen rapidly in a Leyden jar, the outside coating not being insulated, the jar receives a feeble electrical charge, the inside being positive, the outside negative. If this ice be rapidly thawed, an inverse result is obtained, the interior becomes negative, and the outside positive.—*Grothus.*

Experiments and Observations on the Developement of Magnetical Properties in Steel and Iron, by Percussion.—By W. SCORESBY, Jun. F.R.S.E.—After adverting to the general results of his former inquiries, (see page 111, Vol. I.) the author observes, that his principal objects on the present occasion were to endeavour, by auxiliary rods of iron, to increase the degree of magnetism, and to ascertain on what circumstances as to the magnitude of the iron rods, and the quality, size, and temper of the steel wires, the utmost success of the method depends. He formerly used a single iron rod, upon which the *steel* bars were hammered, both being in a vertical position. He now places the steel wire between two rods of iron, and subjecting it through the medium of the upper rod to percussion, derives the advantage of the magnetism of both rods of iron acting at the same time upon both its poles. The rods he used were of the respective lengths of three feet and one foot, and an inch diameter; and the upper end of the larger rod and the lower one of the

smaller rod were made conical, there being an indentation in each to receive the ends of the steel wire. Some magnetism was then elicited by percussion in the larger rod, and the steel wire being properly placed between its upper extremity and the lower one of the small rod, the upper end of the latter was hammered, and magnetism thus communicated to the wire; whilst the lower rod receiving some influence from the percussion, performed a similar office. The author calls this mode of proceeding the *compound process*, to distinguish it from the mere hammering of the wire upon the rod, as practised by him formerly, and which he terms the *simple process*. He then enters into extended details of his several experiments, of which the following are the principal results. 1. That the *compound process* is more effectual in the production of magnetism than the *simple* one, though the ratio of augmentation does not appear determinate. In one experiment, the maximum effect of the simple process was an attractive force capable of lifting between 186 and 246 grains, while the compound process augmented the lifting power to 326 grains. In another, the simple process gave a lifting power of 246, the compound, of 345 grains. Moreover, the efficacy of the compound process is much less manifest upon long than short wires; and the softer the wire, the more susceptible it becomes of this magnetic condition. The author concludes this paper with some theoretical remarks respecting the influence of percussion in disposing the particles of iron to receive and retain magnetism, which he thinks may tend to explain some otherwise obscure phenomena, and which seem to render it probable that the process of percussion may be applied, in connexion with other modes of magnetising, for giving increased power to magnets.—*Quarterly Journal of Science.*

Combustion of Iron by Sulphur.—Dr. Hare makes this experiment in the following manner:—A gun-barrel is heated red at the butt end, and a piece of sulphur thrown into it; then either blowing through the barrel, or closing the mouth with a cork, will produce a jet of sulphurous vapour at the touch-hole, to which if iron wire be exposed, it will burn as if ignited in oxygen gas, and fall in fused globules of proto-sulphuret of iron.

Test of the Alteration of Solutions by contact with Air—M. Becquerel remarks, that if iron be dissolved in nitric acid, and the solution filtered, and two plates of platina, conected with the two extremities of the wire of a galvanoscope, be immersed into the solution, and if one plate be withdrawn, and then re-introduced into the solution, it will produce an electric current passing from this plate to the other; and generally the plate withdrawn from the solution and re-introduced becomes positively electrical. The nitrates of copper and lead give similar results, but they do not retain this power, and in the course of a few hours no effects of this kind are observable. Nitrate of zinc does not operate in this manner. Suspecting that the effect was due to the action of air on the film of solution which adheres to the withdrawn plate, the experiment was made in an atmosphere of hydrogen, and then no such results were obtained. M. Becquerel, therefore, attributes the effect to the alteration induced by the air on the portion of solution withdrawn with the plate, and which, when the plate is re-immersed, being dissimilar to the fluid that has not been exposed, determines the current of electricity. The effect of the air, he considers, is probably to convert such portion of deutoxide of azote and proto-nitrate, as may have been formed by the action of nitric acid on the metal, into nitrous acid and deuto-nitrate; and that when this has taken place with all the portions of the solution, the power of producing electrical currents ceases.—*Ann. de Chim.* xxv. 413.

Action of Meconic Acid on the Animal Economy.—Doubts having arisen with regard to the effects produced by pure meconic acid and the meconiates on the animal system, i Signori Fenoglio, Cesare, and Blengini, of Turin, prepared some of these substances very carefully, and administered them in cases where the results could be accurately observed. It was found that eight grains of any of these substances produced no deleterious effects on dogs, crows, or frogs; nor on a horse even when the dose was repeated. The meconiates were also administered to two persons in cases of tænia, in doses of four grains, but without producing any effect either on the persons or the worms. These results agree with those obtained by MM. Suertuerner and Sœmmering; and in those cases where death was pro-

duced by doses of a grain of meconic acid, Dr. Fenoglio attributes the results to the defective preparation of the substance, and the presence of morphia in it; and the symptoms observed seem to accord with this opinion.

Natural History.—M. Cuvier lately presented a Report to the Academy of Sciences on the state of Natural History, and the increase of our knowledge in that department since the return of maritime peace, the details of which are peculiarly interesting. Linnæus, in 1778, indicated about 8000 species of plants. M. Decandolle now describes 40,000, and within a few years they will doubtless exceed 50,000. Buffon estimated the number of quadrupeds at about 300. M. Desmarets has just enumerated above 700, and he is far from considering this list complete. M. de Lacepede wrote twenty years ago the history of all the known species of fish; the whole did not amount to 1500. The cabinet of the King alone has now 2500, which, says M. Cuvier, are but a small proportion of those which the seas and river would furnish. We no longer venture to fix numbers for the birds and reptiles; the cabinets are crowded with new species, which require to be classed. Above all, we are confounded at the continually increasing number of insects: it is by thousands that travellers bring them from the hot climates; the cabinet of the King contains above 25,000 species; and there are at least as many more in the various cabinets of Europe. The work of M. Strauss, on the May-bug, has just shown that this little body, of an inch in length, has 306 hard pieces, serving as envelopes, 494 muscles, 24 pair of nerves, 48 pair of tracheæ.

Spots on the Sun.—An amateur of astronomy at Prague, M. de Biela, an officer of grenadiers, remarked two facts highly important to that science in the last comet, which was discovered by him on the 30th December, last year. The first of these facts confirms an opinion which he had previously advanced, that the proximity of comets has an influence on the luminous state of the sun. In fact, from the 23d and 24th of October 1822, the period at which a comet was in his perihelion, until the 5th of December 1823, he did not observe any spot in the sun. On the 5th of December he saw a large spot, which regularly increased on the surface of the sun till the 13th of December. On the 21st of the same month a second large spot was observed about to quit the surface of the sun, and which had no doubt been produced some short time before. On the 30th of December the first spot again became visible on that half of the sun which was turned towards us, and continued regularly to enlarge until the 6th of January 1824, when gloomy weather prevented it from being longer observed. It is calculated that the comet passed into its perihelion in the night between the 9th and the 10th of December, at a distance from the sun of about half that of Mercury. On the 7th of January, the time at which the first spot ought to have shown itself for the third time on the sun, it did not appear; and the sun remained without spots until the 16th of January. If this discovery of a relation between comets and the spots in the sun should be confirmed, it will be very important; for, several astronomers, besides Herschell, have remarked that the spots in the sun have a sensible influence on our temperature.—The second phenomenon observed by M. de Biela was, that in the night between the 22d and 23d of January, the comet, besides the tail on the side opposite the sun, had another turned towards the sun. These two tails were not exactly opposite to one another, but formed a very obtuse angle. M. de Biela, who is certain that there was no optical illusion, either in the instrument or in the eye of the observer, thinks that the most probable explanation of this second tail is, that the comet, like many other meteors, had left behind it a luminous track in its passage; and that this second tail indicated the path which the comet had just travelled. It was neither so brilliant nor so long as the tail, properly so called, opposite to the sun; and was observed only on the 22d, the 25th, and the 27th of January; neither before nor after.

Preservation of Plants.—Plants may be completely protected from the depredations of insects, by washing them with a solution of bitter aloes; and the use of this wash does not injure the health of these plants in the slightest degree; and, wherever the solution has been used, insects have not been observed to attack the plants again.

Machine to Prevent Drowning.—A new

machine has been invented as a substitute for the Scaphander, and to preserve from drowning. It is made of tin, in the form of two cones lengthened as a distaff, and strongly joined together. It is so contrived as to come under the arm-pits. A river may be safely crossed with it by any individual, though loaded. It has been successfully tried for half an hour together, before numerous spectators, and bears the name of *Rouanette*, from its inventor M. Rouan, of Paris.

Sheathing Ships with Leather.—It has been found, from actual experiments, that leather immersed in water is not subject to decay or to be eaten by worms, nor does it waste by the wash of the water. Hence it is supposed that there would be great economy in substituting it for copper, zinc, or even for wood, for the sheathing of ships' bottoms; also, for covering the logs and fenders of our wharfs, they being liable to be eaten by the worms. A ship lately returned from the South Seas, after an absence of thirty-seven months, which had a side of soal leather put on her bottom before she sailed, and when she returned it appeared more firm and better than when first put on—the worms had not bored it, nor did it foul much, if any, more than copper.

Interesting Discovery.—Professor Olmsted, of the University of North Carolina, has ascertained that a fine illuminating gas may be obtained from cotton seed. The product of gas from a bushel of seed is more than double the average product of the same quantity of Newcastle coal, and greatly exceeds that in illuminating power. It partakes of the purity and splendour of gas from oil, with which substance, indeed, this seed is known to abound.

The experiments already made induce the belief, that, among all substances hitherto tried for gas illumination, this article will be found the most eligible, especially for our southern cities, where cotton seed can be obtained at a very trifling expense; and the idea is suggested that this article may possibly become of considerable value for exportation. The vast quantity of seed, amounting to many millions of pounds, that annually accumulate in our cotton districts, forming a pile almost useless and sometimes noxious, would, it is thought, afford materials for illuminating almost every city in the United States.

It is expected that Mr. Olmsted will shortly make public his experiments and scientific results on this subject.

VARIOUS COMMUNICATIONS.

ON LAMP-GLASSES.

SIR,—In No. 33, a Correspondent complains of "the chrystal chimneys pertaining to gas chandeliers, oil-lamps, &c. rending asunder," and that too "at times when neither heat nor external force is applied to them."

With this "Sufferer," not a few, we are persuaded, will sympathize; for, in his feelings—to his comfort be it told—multitudes participate. Of the cylindrical glasses, to which your Correspondent alludes, we, for our own part, at one time, saw so many break, that we (forgive us) could scarce help suspecting that the honest manufacturer intentionally contrived to make them fragile. Time, however, discovered that we ourselves rather contributed towards this purpose, being wont, in order to cleaning, to immerse them in cold water, and the glass, of itself sufficiently brittle, being thus, by opposite extremes, rendered more so perhaps, necessarily yields to the pressure of the circumambient air. This unphilosophical custom we have, however, relinquished; and now, if we want to clean our glasses, we breathe *into* and *upon* them, and then rub them well with a linen towel. By this mode, one, and the same set of glasses, has served us for this twelve months past; how long they may yet hold out is uncertain. This *recipe*, Mr. Editor, please make public, and the public will perhaps have good cause to thank you.

L. M'L.

ASTRONOMICAL QUERY.

SIR,—I do not know that the stars can be "better seen," or "even best seen," from the bottom of a well, though I have heard that truth lay there. I have tried, and no doubt many others have, the view from the mountain tops. Did ever a "Sceptic" try a chimney above ground? it is far from being a wieldy instrument for astronomical ob-

servations; but it is nearly as much so as a coal-pit, which may be considered as a deep pit. Let him try the chimney of a steam-engine, (before the fire is put on,) and then tell us.

Will any of your optical friends tell us, if there be any other thing that can mend the sight, except the sides of the pit, or funnel, guiding it?

I will now tell you what happened about a dozen of years before the last century closed its existence. The planet Venus, was seen at her farthest distance from the sun, in broad day; and where do you think she was first discovered—in a pit or on a mountain top? Both. It was, Sir, on the top of a high mountain, where was a slate quarry, and in one of the pits the planet was seen. The country folks stared—the philosophers might have done otherwise—but the people tried whether she could or could not be seen on the plain; and true it was, and of verity, that she was seen in the level country on the plain surface. But it required a little management, and I will tell you the simple mode that I was recommended to use, by a certain self-taught philosopher, yet in existence. I got into the shade of a building—kept my eye along the wall, near the place where Madam was to be expected—and shifted my posture till I found her. Was there any thing else in the side of the wall than its keeping off the rays of the summer sun, and guiding the vision direct to the object?

A.

ON BLASTING TREES.

SIR,—Any device that has a tendency to diminish human labour to a certain extent, ought to be submitted to strict investigation, and if found adequate to the purpose, ought to be uniformly adopted.

When on a wooding party, for ship-firing, on one occasion, I thought, that instead of using the axe and the saw, the whole might be blasted. The experiment was made, and succeeded beyond expectation. From this, it may be seen, all the heavy timber, either for fire-wood, or for making potashes, should be blasted, as by far the readiest mode of obtaining a speedy supply. In Canada and Africa, this plan would be of infinite importance to settlers, and indeed in all countries, where the wood is abundant and prevents the cultivation of the land. All that is necessary to produce the desired effect, viz., the destruction of the tree, is to bore a hole with an augre, inclining towards the root of the tree, to fill it up with gunpowder, and to cause it to explode in the usual way. Any settler in a mild country, that needs clearing of large timber, will clear more in one day, by this means, than by the axe, or saw, in a week; and the ground has this additional advantage, that it is all loosened a great way round, and of course much more easily cultivated.

I am, Sir, your's,

C. D.

NOTICES TO CORRESPONDENTS.

"An Account of THREE LARGE LOADSTONES, one of which presented an unusual line of attraction," by John Deuchar, M. W. S. and Lecturer on Chemistry in Edinburgh, will appear in our next.—Communications from M., F. T., J. D. C., and others, have been received, and are under consideration.—James Jones's idea of an inflammable gas engine seems ingenious, but it requires to be a little more matured; we wish he would explain more distinctly his mode of connecting the motion of the piston with the explosion of the gas. When he has completed his plan, we shall be glad to hear from him again.—As the Gallowgate Grocer, and his friends, don't seem satisfied with what they have got, we shall be at them again next week.—*Niger* only wants *Custos* to complete his title.—We shall be much obliged to R. D. if he will transmit the work he mentions.

ERRATA.

In a few Copies of our last, p. 67, col. 2, lines 5 and 6, *for* B, *read* B'; and in fig. 2, *where the circle cuts the line* D "*a*," *insert* B'.—Vol. II, p. 42, *Paradox*, line 7, *for* A D C, *read* A B C.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written. Original Patents, Inventions, &c. will be inserted on the shortest notice.

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THE GLASGOW
MECHANICS' MAGAZINE.

"The human genius, like revolving suns,
An equal circuit in the bosom runs;
And through the various climates where 'tis plac'd,
Must strike out new diversities of taste."

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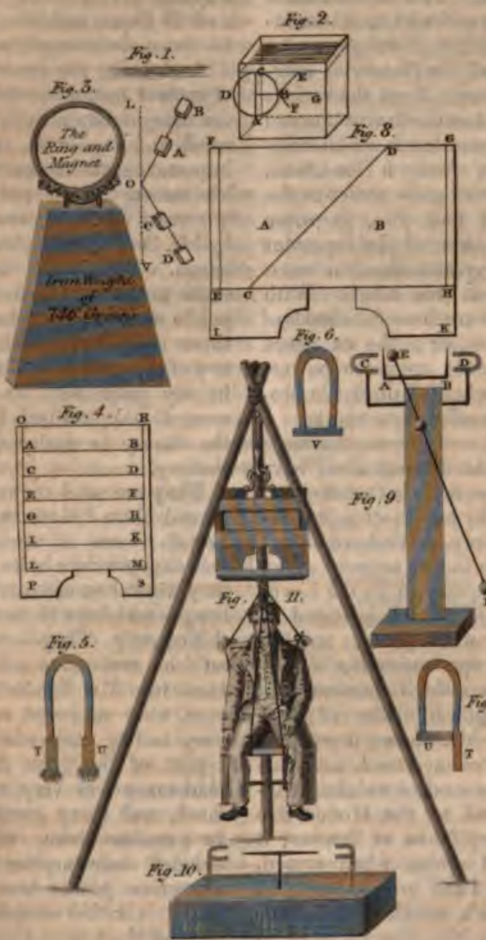
MAGNETIC AND HYDROSTATIC EXPERIMENTS.



Swan Sculp^t

AN ACCOUNT OF THREE LARGE LOADSTONES,

One of which presented an unusual Line of Attraction.

By John Deuchar, M. W. S. and Lecturer on Chemistry in Edinburgh.

(Read before the Wernerian Natural History Society, 10th March, 1821.)

When we come to try the magnetic energy of large loadstones, or natural magnets, we seldom find them to display that force, in proportion to their size, which we should expect. This circumstance seems to have drawn to it the attention of philosophers at a very early period of the history of magnetism; and hence, from the various facts they had noticed, was formed the conclusion, that a small fragment broken from a loadstone, might possess as great power as the whole mass; and that, in some cases, the power of the fragment was actually greater than the mass from which it was taken. With regard to the truth or falsehood of this hypothesis, or to the existence of the specimens upon the powers of which it is built, I do not at present mean to offer any remark.

It is a fact well known, that large masses of this mineral often have a weak power, and that small specimens generally have a stronger proportional energy. We have an example of this in the account given of the large specimen in the Leverean Museum, which is stated to have a very weak power; and the three small specimens noticed by Mr. Martin, which presented a very great power. One of these belonged to Mr. Haac; it weighed $14\frac{1}{2}$ ounces when armed, and carried 16 times its own weight. Another belonged to the Honourable Mr. Berkeley, then at Bruton; it weighed 43 grains when armed, and carried 1032 grains, being 24 times its own weight. And the third, which Mr. Newton wore in a ring, weighed scarce three grains, it took up 746 grains, being 250 times its own weight, see fig. 3. In these three small specimens we find the power of attraction to be comparatively greatest the smaller their size is. Mr. Newton's carried no less than 250 times its weight, whereas Mr. Berkeley's only carried 24 times, and Mr. Haac's only 16 times, their respective weights.

Such being the general character of natural magnets, with regard to the comparative attractive power of small and large ones, it is of some importance to notice three large loadstones, which arrived here a few years ago, and were purchased by Mr. Sanderson, lapidary in Edinburgh. These form an exception so far to the above conclusions. No public notice has yet been taken of these natural productions; and as two of them remained for ten months in my possession, and presented several peculiarities, I now take the liberty to notice them to the Society.

They are said to have been removed from Moscow, when the French were advancing towards that city, previous to its being burnt; they were then conveyed to Petersburgh, and from thence shipped to this country. They were cased with an iron armature; and, when they came into Mr. Sanderson's possession, were supposed to have but a very trifling magnetic power. A report of the great size of these loadstones was very rapidly circulated, and many gentlemen called to examine them, who generally evinced their surprise that so little attractive power was displayed; but it is rather extraordinary that none of them traced out the cause, which we can only attribute to the rusty state in which the magnets were at the time: be this, however,

the case or not, there can be little doubt that the full energy of these valuable minerals might still have remained latent, as they were for some time laid by as nearly useless, had not Mr. Sanderson thought of cleaning them, to see what effect that might have. For which purpose, the iron armature was removed; and this was scarcely done, when the cause of the inactivity was found to have rested in the armature, for the unarmed loadstone now lifted pieces of iron. They were thereafter armed with copper and brass, and began to exhibit an increasing power, as additional weights were added to them.

It may appear, at first view of the circumstance, that the person who armed these magnets with iron displayed little knowledge of magnetism; but, upon considering it more maturely, we will form an opposite opinion. Let us for a moment trace the effect of such an armature. The two surfaces, upon which the artificial poles are placed, present innumerable magnetic points, or so far combined poles—and soft iron has the power of receiving and conveying these to a focus, as it were. Now, suppose N (see fig. 4,) to be a magnet, and the lines O P and R S its two polar surfaces; if we put a slip of soft iron round the portion marked A B, then that soft iron receives the magnetism of all the polar surface which it covers, and conveys it round in a circle, and will thus take away so much of the full energy of N: if we now put another strip of soft iron round C D of the magnet, we in the same way cut off from action another portion of the magnetic surface of N: and, if we proceed to add more strips of iron, as E F, G H, I K, and L M, we gradually weaken the effective power of N, till we nearly prevent it altogether. This might be illustrated by numerous experiments. Let us select one. Let us apply, to the poles of a horse-shoe magnet, (as shown in fig. 5,) two such pieces of soft iron as are usually employed to connect the two kinds of magnetism, (T and U,) and leaving them in contact with iron-filings, and they will be attracted to T and U in great abundance: now place a similar piece of soft iron (see fig. 6,) on both poles, and V will not attract iron-filings, for the magnetic circle is complete. If, again, we place the pieces of soft iron, T and U, (as shown in fig. 7,) then T will show scarcely any power of attraction; but, if we draw away U, the attraction of T becomes powerful, and is again lost when we return U to its situation. From all these facts, then, it would appear, that, when we complete the magnetic circle, we prevent considerably the escape of the attracting power, or rather, I should say, we retain the required activity of the magnet. And it was most likely for this purpose that these magnets were covered with an iron armature.

The largest of the loadstones, independent of its armature and connecting iron, weighs $125\frac{1}{2}$ pounds; and it measures,

In length, ...	$10\frac{3}{4}$	inches.
... breadth, ...	$8\frac{1}{4}$	...
... height, ...	$9\frac{1}{2}$	...

When I received it, it could carry 163 pounds; but, by gradually increasing the weight, I afterwards brought it to support 165 pounds, exclusive of a connecting iron of about 28 pounds, and the ropes and pullies, which might be 12 pounds more, making in all 205 pounds; thus giving an improved power equal to 42 pounds. This loadstone is now in the possession of Dr. Hope, Professor of Chemistry in Edinburgh, and is the most powerful one of its size of which we have any recorded account. And it must be

gratifying to know, that this valuable specimen is not to be lost to science, as it might have been, had it fallen into the possession of a private collector; but that Dr. Hope, with his usual liberality, means it to form an addition to the invaluable collection of minerals in the Museum of the Edinburgh University.

The weight of the second loadstone, independent of its armature and connecting iron, is 28¼ pounds; it measures,

In length,...........	5⅛	inches.
... breadth,.........	4	...
... height,...........	8	...

On the 28th November, 1818, I had suspended from it a mass of calcedony, weighing 80 pounds, to which is to be added the weight of the connecting iron and ropes, which is 5½ pounds. This loadstone is still in the possession of Mr. Sanderson.

The third of these minerals I have never seen, but I understand its size and power are intermediate between the two first. It is now the property of Gilbert Innes, Esq. of Stowe.

These natural magnets came to this country in the same vessel; and, during their passage, the two first mentioned had been placed beside each other with their improper poles in contact, by means of which, the weaker one had its poles changed, the north being converted into a south, and the south into a north pole.

A curious circumstance, which I found to be exhibited by the largest of these three loadstones, deserves particular notice. The full energy of the south pole was not displayed at E (fig. 8), nor did it run along the line E F, as is usual; but it was strongest at C, more than an inch from the proper situation of the south pole of the mass, and the force of the south attraction ran along the line C D. The north pole, however, was quite correct, being most powerful at H, and along the line H G. It may be proper here to notice, that these lines of attraction were ascertained by means of a small pocket-compass, about one inch in length, which was very delicate, and most sensibly affected by the slightest changes from the lines of attraction just mentioned. In case the peculiar situation of the loadstone might have any effect, the position was changed in various trials, and the same results always accompanied the application of the small compass. The experiment was again repeated, to discover what effect an attached weight might have on the result, when it was invariably found, that weights of different sizes, such as 20, 40, 60, 80, 100, 150, and even 205 pounds, had no influence in altering the line of south attraction along C D. Such, then, is the fact with regard to the south pole of this loadstone, and we are naturally led to trace some cause for so unusual an appearance. It may arise from one of three circumstances:

1st, The part A, cut off by the line of south attraction C D, may be a mass of ironstone unmagnetic, which, of course, by its presence, may not much affect the full force of attraction at the artificial south pole.

2dly, The part A, may be an ironstone-paste, added by art, for the purpose of completing the shape of the loadstone,—as is generally done, in smaller quantities, when slight irregularities occur in shaping the natural stone. The presence of this paste may not weaken the magnetic force of B obtained at the connecting poles. Or,

3dly, A, may be a distinct loadstone, of a smaller size, and probably a very weak one, in comparison

with B, but still possessing the full characters of a complete magnet; in which case, it must have a tendency so far to weaken the power of B. From its magnetic energy being less, A cannot change the poles of B, nor alter the line of its attraction, but it may probably weaken them:—on the other hand, B, possessing the strong power, will alter the poles of A, so as to correspond with its own; that is to say, the part of A immediately in contact with C, will be converted into a north pole, and the part at E will be converted into a south pole. From this, it follows, that when the different weights noticed are attracted by the artificial poles I K, they are not sustained there solely by the energy of B; but by the strong north pole of B, and the weak south pole of A, to which last may very likely be added a minute portion of south attraction conveyed through A from C to E; but this quantity must be very small, from the combined effects of the attraction at C, and the repulsion at E, for south magnetism. Thus, the artificial pole I, will not keep up a corresponding strength with K; and this appears verified by experiment, for the small compass was found not to be attracted so powerfully by one-half at E as at H, or at I as at K, nor at C as at H, for the whole south situations seemed to be weakened in their power. From the external appearance also of the loadstone, on both sides of the line of extreme south attraction C D, this third seems the more probable nature of A. If we allow this to be the case, then, by removing A, we must greatly add to the quantity of magnetic effect displayed at the two poles; but as a loadstone is very apt to be injured by being struck forcibly, it might be hazardous to make the trial.

Before concluding this paper, I may take notice of an imposition which was, about three years ago, attempted to be kept up upon the prosecutors of science in different parts of the united kingdoms by a needy shoemaker, of the name of Spence, as this disgraceful fraud was first exposed by means of the largest of the magnets just explained. This individual pretended he had discovered a black substance which did not conduct magnetic energy through it, and he wished it to appear, that when this substance was made to come between a steel beam and a magnet, the power of attraction was at least lessened, if not altogether stopped. He placed machinery in such a situation as not to be observed, and, with the assistance of a few falsehoods, which he found very useful in raising the curiosity and extorting the charity of credulous visitors, he tried to induce a belief that a pendulum was then moving a clock, and had continued to do so for six months, without any other exciting power than two small magnets. This is shewn in fig 9. A B are the two supposed non-conductors of magnetism, affixed to the opposite ends of a beam moving on its centre; C D are the two magnets, which were said to attract alternately the end E of the pendulum E F. At the commencement of the motion of the pendulum, it was said that one of the pieces of the black substance, say A, was moved from between the magnet C and the pendulum; this enabled the attraction between C E to take place, and cut off the attraction between D E; and this is the state in which the figure on the plate is drawn. But as E approaches nearer to C, so as to present the actual contact of C E, then A moves up, and entirely cuts off the effect, and at the same time B leaves the power of D in full action; therefore E moves from C towards D, and, when it has nearly

arrived there, B again moves up, and A descends: and thus, it was maintained, the continued motion of the pendulum was kept up.

Another way of exhibiting this deception is shown in fig 10. Here, by the false account given, we are told, that a very fine steel beam, about an inch in length, has been made to revolve with great rapidity for many months, and that two magnets, partially coated with the extraordinary black substance already noticed, and placed at opposite sides, are the sole cause of the motion. This motion, it is almost unnecessary to add, was also induced by secreted machinery in the box on which it rested. On one of the nights of lecture, when I was upon the subject of magnetism, this scientific juggler brought his perpetual motion, as he called it, to the class-room. As at this time I had the largest of the three magnets (fig. 11) suspended there, for the purpose of explaining its pecularities and powers, I thought it would be a good opportunity to try the truth of his assertion with regard to the cause of the motion. I therefore placed the revolving needle (fig. 10) on a table under the large magnet, while the usual weight which it carried was removed, but the needle moved as rapidly as before. Here, then, a loadstone, capable of lifting 205 pounds, did not affect a needle, said to be moved by two very small artificial horse-shoe magnets. On another occasion, I placed a piece of the black substance, which was called a non-conductor, between a magnet and a magnetised sewing-needle, which I balanced on the point of my finger, and I found it to be attracted and repelled, as the different poles were presented, in the same way as if no such black substance had intervened.

JOHN DEUCHAR.

Explanation of the Plate.

[Figs. 1 and 2 refer to the Hydrostatic Paradoxes, pp. 82, 83, Vol. II.]

Fig. 3. Represents the original size of Mr. Newton's magnetic ring, and the weight attached to it.

4. A magnet, surrounded by slips of iron A B, C D, E F, G H, I K, and L M.

5, 6, and 7. Horse-shoe magnets, with flat bars of soft iron, T, U, and V, attached to them, to show the effect of completing and breaking off the magnetic circle.

8. Dr. Hope's large magnet, showing its unusual line of attraction C D.

9. The pretended pendulum-motion by magnetism.

10. The pretended perpetual magnetic motion.

11. Represents Dr. Hope's large magnet, as it was suspended in Mr. Deuchar's class-room, for the purpose of allowing the pupils attending to try its great power.

SOLUTION OF THE CRANE QUERY.

SIR,—The following is a solution to the query of A. W. at page 360, Vol. I.

Let A B C D E, fig. 3, p. 353, represent the crane, and W, a weight suspended from the point E of the arm C E.

It is evident, from the well known property of the lever, that C D is to C E, as the weight W to the pressure, or force, at the point D, in a direction downward, and perpendicular to the horizon. Hence, the pressure, or force, in that direction, at the point D, is equal to $\frac{CE \times W}{CD}$.

The pressure, or force, at the end D of the spur, or, at the point D, in the direction D B, is the resultant of two forces acting at the point D. One in the direction D C, the arm of the crane, and the other in a direction downward, and perpendicular to the horizon, or parallel to the upright post A B C. Let D C represent the former of these forces, and C B the latter, that is, the force $\frac{CE \times W}{CD}$; then will D B represent the force, or pressure, at the end D of the spur, or the force in the direction D B. Now, C B is to D B, as $\frac{CE \times W}{CD}$ to the pressure at the end D of the spur. Hence, the pressure at the end D of the spur, is equal to $\frac{DB \times CE \times W}{CB \times CD}$.

Through D, draw D F parallel to C B, and through B, draw B F perpendicular to C B, and cutting D F perpendicularly in F. Let the force D B be resolved into the two forces D F and F B, of which G B presses perpendicularly against A B C. Now, D B is to F B, as $\frac{DB \times CE \times W}{CB \times CD}$ (that is the force D B) to the pressure, perpendicularly, against A B C. Hence, the pressure, perpendicularly, against the upright post A B C, is equal to $\frac{FB \times DB \times CE \times W}{DB \times CB \times CD}$ $= \frac{FB \times CE \times W}{CB \times CD}, = \frac{CE \times W}{CB}$; because $FB = CD$.

I am, Sir, your's, &c.

J. D. C.

Glasgow, 24th August, 1824.

The above may be illustrated numerically, thus: Let $CE = 20$ feet, $BC = 12$ feet, $CD = 5$ feet, and $W = 3$ tons. Then $BD = \sqrt{CD^2 + BC^2} = \sqrt{25 + 144}$ $= 13$ft. Hence, $\frac{DB \times CE \times W}{BC.CD}$ $= \frac{13.20.3}{12.5} = 13$ tons for the pressure on the spur D B. Also, $\frac{CE \times W}{CB} = \frac{20.3}{12} = 5$ tons, the force tending to break the post A C at B. And $\frac{CE \times W}{CD} =$ $\frac{20 \times 3}{5} = 12$ tons, the force, or pressure, at the point D.

ON THE EIDOGRAPH.

Mr. Editor,—I think Professor Wallace's Eidograph is not exactly complete; the string is rather an inconvenient mode of lifting the point, instead of which I would recommend the adoption of four levers; two to be placed on the beam A B, (see the figure in No. XVI. page 241, Vol. I.) so that when your finger pressed down the end of the one, the opposite end of the other would go down. The other two must be placed on the two arms at F, and the tracing point fastened to the end of the one, and the marking pencil to the other; so that, by lifting the tracing point, the pencil will also be raised off the copy. I would have a kind of slide made on the inner ends of the two pencil levers, so that they could be lengthened or shortened, as the two arms F are meant to be lengthened or shortened; because, unless they were also altered, the levers would not communicate. The end of the lever should be made heavy enough to leave a pencil mark on the copy; and the pencil might be put into an open tube and fastened in it, with a screw like the leg of a pair of mathematical compasses.

Jas. Jones.

Edinburgh, 9th August, 1824.

On Mr. ROBERTSON's MACHINE for Hauling Vessels up the River.

Sir,—I beg leave to hint an improvement in the use of *Mr. Matthew Robertson's machine for floating vessels on the river Clyde.* In some part of Holland, (I think Amsterdam,) there is a machine used somewhat similar to Mr. Robertson's. The only difference is, that it is hollow; and, when it is to be used, the water is admitted into the interior, till the vessel is rightly placed; then the water is pumped out, and the vessel rises to any height required, as the *Camel* of itself is very light, or buoyant. This plan, or some modification of it, might be applied to Mr. Robertson's machine, and thus render it useful in your beautiful river, which furnishes support for thousands, and extends its commerce to every quarter of the habitable globe.

Jas. Jones.

Edinburgh, 25th August, 1824.

CURIOUS AND USEFUL QUESTIONS.

CONICAL TUB.

1. Given the difference of the diameters of a tub, (in the form of the frustum of a cone;) = 11 inches, and the depth is the mean proportional between the diameters; the content in wine, exceeding the content in ale gallons by 17.344788, required the dimensions?—G. D.

GENTLEMAN's HOUSE.

2. A gentleman's house, situated with a perfect plane in the front, with two wings projecting 60 feet from the body of the house, terminates with two square towers, the main door being in the centre of the main building. A person wishing to take a survey of the building from a station in a direct line from the door, took the following angles, *viz.* between the towers 55^{0}, the elevation of the right hand tower being 25^{0}, and the left tower 27^{0}, at 100 feet beyond the first station, in the same direction, the angle between the towers was 35^{0}; required the length of the house, (each wing being 30 feet,) the distance between the towers, the height of each, and the distance of each station from the door?—G. D. (Master R. N.)

ROOTS OF EQUATIONS.

3. Sir,—Will you, or any of your Correspondents, inform us who is the discoverer of the new method of finding the roots of equation, and where an account of it may be found?—F. T.

FORCES.

4. A weight of 2 cwt. is suspended by a string, what force must I employ so as to make the string form an angle of 23^{0} with its former position?—F. T.

DISTANCES.

5. The distance between Hamilton and Glasgow is eleven miles: H starts from Hamilton, and G from Glasgow, at the same time;—from the point of meeting on the road, H takes two hours to reach Glasgow, and G one hour to reach Hamilton: what time did each take to perform the journey, and at what distance from Glasgow did they meet?—G. B.

TREES.

6. It is required to plant four trees at equal distances from each other, (that is) each tree must be equi-distant from the other three?—G. B.

APPLES.

7. A countryman had three daughters, who were going to market with the produce of the dairy:

To the eldest he gave sixteen apples of a rare kind; to the second twelve; and to the youngest eight. They sold their apples all at the same rate, and yet each daughter's apples produced the same money; at what rate were they sold?—G. B.

WHEELS.

8. Suppose a large wheel A, of 576 teeth, to drive four smaller wheels, B of 360 teeth, C of 234 teeth, D of 168 teeth, and E of 128 teeth; and, supposing that the four teeth of the wheel A, which are in contact with one in each of the other four wheels are marked with chalk: after how many revolutions of the large wheel A will all the marked teeth be again in contact for the first time?—RUSTICUS.

SCALES.

9. In what Arithmetical scale, will 649, in our common rotation, be expressed by 243?—RUSTICUS.

ON THE PREVENTION OF ACCIDENTS ARISING FROM MACHINERY.

SIR,—After all the precautions which are taken to guard workmen from the danger that arises from going too near the machinery in our cotton mills and other public works, still fatal accidents very frequently happen. Some farther means should therefore be adopted, if practicable, to prevent the occurrence of such accidents, or to mitigate their severity when they do occur.

One plan, which I think would be extremely useful in accomplishing this end, is to cause every flat, or apartment, where such machinery is placed, to be furnished with a bell-pull, connected with a bell in the engine-house, which, being rung whenever any person got entangled in the machinery, would warn the engine-man to stop the engine immediately. For this purpose, also, two or three of the workmen in each flat, or apartment, nearest to the bell-pull, should have the charge of it, and be accountable for its being rung when no danger is apparent.

On the supposition that the engine-man might not be at hand when required, at least, to stop the engine so speedily as might be necessary, some other plan might be easily adopted. For instance, a rope might be placed in each apartment, so connected with the engine, and under the constant charge of an individual, so that whenever it was pulled the engine would be instantaneously stopt; or, the main shaft, in each flat, could be so constructed as to be quickly thrown out of gearing, and so prevent the direful effects of such accidents as I have mentioned. Other plans might perhaps be adopted, more suited to the peculiarities of machinery; these, indeed, will readily suggest themselves to the ingenious mechanic; what I have thrown out, being merely intended as hints which may be useful in calling their attention to the subject.

I am, SIR, your's, &c.

J. S.

Glasgow, 30th August, 1824.

IMPROVEMENT ON STEAM BOAT ENGINES.

SIR,—In coming up the Clyde the other day, in a steam boat, I was struck with the extreme simplicity of its engine, which impelled the wheels without the intervention of beams, by a crank on the axle of the paddle-wheels connected to the piston by what is termed the connecting rod. Upon questioning the engineer, I found that this simple

and ingenious mode of working the paddles, was in general superseded in practice by the clumsy appendages of large working beams, on account of the want of space above the engines in steam boats, which occasions the connecting rod to be too short. I immediately saw that this inconvenience might be obviated by inverting the cylinder, when the connecting rods would extend from the end of the piston (now at the bottom of the cylinder,) to the crank on the axle of the paddle-wheels. The connecting rods would thus be nearly three times as long as at present; and, if no practical objections occur to this plan, it may be the means of getting rid of the most cumbrous part of the machinery in the steam boats at present.

I am, Sir, your's, &c.

Ignotus.

ON PROGNOSTIC SIGNS OF THE WEATHER.

(Concluded from page 89, Vol. II.)

From the Dew.

If the dew lies plentifully upon the grass after a fair day, another fair day may be expected; but if after such fair day there is no dew upon the ground, and no wind stirring, it is a sign that the vapours go upward, and that there will be an accumulation above, which must terminate in rain.

If the dew or hoar frost are very abundant at a season when they are not generally produced, and the barometer low, it is in general a sign of rain.

From the Face of the Sky.

The colour of the sky is an index to the weather, because it shows the state of the vapours which reside in the atmosphere.

If the red vapours of the evening are precipitated, the morning sky is clear; but if they remain in the air, the morning is red, and rain is in general the consequence.

If a louring redness spreads far upwards from the horizon, either in the morning or in the evening, it is succeeded either by rain or wind, frequently by both. If such a fiery redness extends towards the zenith in an evening, the wind will be high from the west or south west, attended by rain and sometimes succeeded by a flood.

When the sky in a rainy season is tinged with a sea-green colour near the horizon, when it ought to be blue, the rain will continue and increase; if it be of a deep dead blue, it will be showery. The loftiness of the canopy is perhaps one of the truest prognostics of fine weather.

From the Sun, Moon, and Stars.

The appearances of the sun, moon, and stars, give notice of approaching changes in the weather, as the rays which come from them to us must pass through the vapour in the atmosphere, and indicate its state.

The sun rising guadily (the clouds in the east being tinged with an orange colour) is generally esteemed to be a sign of rain.

When there is a haziness high in the air, the light of the sun fading by degrees, and his orb looks whitish and ill defined, it is in general a sign of rain.

If the rays of the sun breaking through the clouds are visible in the air, and appear like the horns of irradiation, which painters place on the head of our Saviour, it shows the air to be filled with vapour, and if other signs concur, it is a proof that rain is at hand.

Virgil says that a pale moon is a sign of rain; that a red one predicts wind, and a white one, and of her natural colour, with a serene sky, fair weather.

If the moon and stars grow dim at night with a haziness in the air, and a ring or halo round the moon, it is a sign of rain; this, however, is not a bad sign if it happen in an evening when the dew is forming; but if they appear at any other time, they prove a general disposition in the air and clouds to let go their vapour under that form which we denominate rain.

Mr. Jones gives us the following observations with respect to the moon's monthly course:—

If the moon be rainy throughout, it will clear up at the ensuing change, and

the rain will probably commence again in a few days and continue; but, on the contrary, if it has been fair throughout, and it rains at the change, the fair weather will probably be restored about the fourth or fifth day of the moon, and continue as before. By this rule he says he has made hay these twenty years, without having once had the mortification to see it damaged by the rain. A farmer who has much work to do, cannot contract it in so small a compass as to reap much benefit from this observation, but a gentleman who cuts hay for his own consumption, will seldom fail to find his account in it.

Dr. Horsley attacks this opinion concerning the moon; and though its influence has attracted the attention of men in all ages, yet he peremptorily asserts that it is a notion in itself improbable, destitute of all foundation in physical theory, and but little supported by any plausible analogy. But the Doctor does not deny that the observant husbandman will find a variety of useful prognostics in the appearances of the moon; but then he says—they will be symptoms destitute of all efficient powers; they will show the present state of the air, as that on which they depend, not as that which they govern, and may furnish probable conjectures for two or three days to come.

From the Wind.

Among the causes that affect the weather, there is none whose influence is more demonstrable than that of the wind; these, though uncertain in appearance, are like all other phenomena of nature, governed by fixed and determinate laws, and deserve a most serious investigation.

When the wind veers about uncertainly to several points of the compass, rain generally follows. By some it has been asserted, that if the wind in veering about follows the course of the sun from east to west, it brings fair weather; but if its course is from west to east, foul. A whistling howling wind is almost an infallible sign of rain.

From Animals.

Those who pay attention to the animal creation, will find in their habitudes many prognostics of the changes of the weather. In the nature of their labours, the uneasiness they testify by the peculiar tone of their voice, or by the precautions they take to shelter themselves, their feelings are probably more acute, and their senses more awake to the delicate impressions of natural causes than ours, where the mind by its continual action diminishes the force of all external impressions.

D. A. N.

VARIOUS COMMUNICATIONS.

ON KNOTS IN TIMBER.

Sir,—In answer to M. A.'s query, (No. XXXII. page 25, Vol. II.) "Why knots of timber are harder than the other parts?" I apprehend the cause to be this: They are, as he remarks, the roots of branches; after these branches have decayed, or have been lopped off, their roots soon get inclosed by the growth of the tree; and, as a portion of the nourishment which would have supported them, had they continued growing, will still be communicated to them, and being bound in by the growth of the timber over them, they are hindered from extending their diameter. Consequently, what nourishment they derive from the growth of the tree must go to augment their hardness and solidity, being precluded from adding to their extension.

G. B.

Hamilton, 26th August, 1824.

INVISIBLE LAMP.

Sir,—In looking over one of your former Numbers, I observe that one of your Correspondents indulges the hope of seeing "the thousand lamps of your City, as if by magic, start into a bright blaze;"—see his story by turning to the article entitled "Self-Igniting Gas," in No. XI. of the Magazine. Would not his objection have been removed, if he had had a knowledge of the principle on which the Invisible Lamp is constructed and named? Surely it is because the platina retains its heat so long, and it would certainly be re-warmed every night in the lamp

I am, Sir, your's, &c.

Jas. Jones.

Edinburgh, 26th August, 1824.

ON SOUND.

Sir,—My attempt to explain the cause of Sound, on holding a shell to the ear,

has been animadverted on by A. B. at page 344, and by S. Y., page 396 of Vol. I. to which I had not before an opportunity of replying.

The remarks of A. B. on the strength or weakness of sounds, under different circumstances, may be just; but seem wholly unconnected with the phenomenon in question. What he says on the latter, is only applicable to the well known instrument for collecting and transmitting external sounds to the ear; if otherwise, the loudest sounds must necessarily predominate, and be distinguishable in the experiment with the shell as well as with the former instrument. If the cause assigned by A. B. were the true one, the external sounds collected by the shell would undoubtedly be heard at a greater distance from the ear; but it must be brought within two inches of the ear to be heard at all, and within a quarter of an inch to produce the greatest effect; but what strikes at the root of A. B.'s argument is, that the sound in the shell is heard at all *times*, and in all *situations*, except overpowered by *external* sounds. For the truth of this, I appeal to every one who has an ear to hear, and a hand to hold a cup or shell to it.

As to S. Y. I fear his wit will spoil his philosophy. We must infer, from what he says, that the *insensible* perspiration is a terrible state, and that it must be suspended in all experiments in Chemistry and Natural Philosophy. His introducing chemistry so strangely here, made me at first think he must be a chemist; but, on a second thought, I concluded that, if so, it must only be in the department of freezing mixtures. The only remark made to the point by S. Y. is, that if my principles are just, the sound must be the louder the closer the shell is held to the ear. I answer, so it is, except when it actually touches the parts, which in all cases disturbs the organ and changes the nature of the sound, but does not prevent it. What farther illustrates the subject, is a simple experiment with a piece of pasteboard, or thin wood, with a hole in it, just so large as not to injure the hearing, when held opposite the ear. Hold the shell over this hole, without removing it from the ear, and you will find that the sound peculiar to it is nearly *cut off*, though external sounds are *not*. Enlarge the hole gradually, holding it and the shell *repeatedly to the ear*, and you will find the sound increase, as the hole is enlarged, till equal to the mouth of the cup or shell, when it will have reached its maximum.

In conclusion, I observe that if the hands are held at once on both ears, and pressed so close as effectually to exclude all external air, as well as sound, a noise is heard of a different tone, but equally loud; so that, with the shell, it even resembles distant thunder. This noise I distinctly ascribe to the same cause; the difference of tone arising from the different form and material of the instrument employed. This latter experiment cuts off the pulsations as well as arguments employed against the theory I have advanced.

I am, Sir, your's, &c.

G. M.

Glasgow, 2d August, 1824.

IMPROVEMENT IN THE SOUNDING LINE.

Sir,—In No. XVII., page 269 of your first volume, G. M. has certainly explained very satisfactorily the cause why soundings cannot be had beyond a certain depth, namely, that the buoyancy of the line will ultimately counteract or balance the weight of the lead. But, Sir, although the cause is thus explained, it still remains *to find a remedy*; and, therefore, I beg leave to suggest the following, as it may perhaps lead to an essential improvement in the construction of lines for deep soundings.

Let a flexible copper wire be spun into the line, of such thickness as to render the line of the same specific gravity as the water, and the inconveniency arising from the buoyancy of the ordinary hemp line will be completely removed. A gentleman who has been frequently at sea, remarked to me that taking deep soundings was a very tedious process. The lead descends rapidly at first, but gradually becomes slower, and at last can hardly produce any motion on the reel, whereas by the adoption of such a line as above proposed, the lead would descend the last fathom as rapidly as the first, and by striking the bottom with much greater force, would fetch up a greater quantity of materials for determining the nature of the channel; it would also save a great deal of time in performing the operation.

I am, Sir, your's, &c.

G. B.

Hamilton 9th August, 1824.

MAKING OF CHEESE.

Sir,—Cheese, I should suppose, is a thing of very ancient invention. That stripling, David, when he humbled proud Goliah, had some cheese in charge, every body knows.

Of cheese the properties are multifarious. It is to the palate, delicious; to the stomach, not unwelcome; * and it constitutes a first-rate provocative. It is, in short, a tit bit, to the peasant and the prince equally acceptable.

How this very useful commodity is manufactured, would, methinks, be an enquiry not uninteresting to a number of your readers, who, though to the article in the abstract no strangers, yet the process of making it, never haply witnessed.

Wherefore, Mr. Editor, as we want to have no recess of either *Art* or *Science* unransacked, this suppositious query, (for a domestic character I have already betrayed myself,) allow me to solve.

Of milk, then, take any quantity; make it lukewarm, put in a small quantum of *worm*, say two drams to each pint, let it rest in the pot for perhaps two hours, till it coagulates; then analyze, (curdle,) or, to speak perhaps more intelligibly, *confound*, with both hands, the congealed matter. After which, compass into one place the floating clods, till by gentle squeezing they gradually conglobe, then this lump remove into a dry dish; work it well with both hands again till it disincorporates. This process I would call *pulverizing*, and indeed of all the operations it is the nicest; it is done in order to *salt*ation, and when not duly attended to, the cheese cannot duly receive the salt; hence, a cheese with worms in it argues a cheese not properly pulverized. This done, transfer the whole in a linen towel into a sturdy wooden dish with holes in it to emit the whey; then, upon the dish put some ponderous weight: a press for the purpose would be preferable. In this *inquisitional* state let it remain for 48 hours, and the net proceeds, if I err not, will be a well embodied *cheese*.

I am, your's, &c.

L. M'L.

* This truth is very much to be doubted.

QUERIES.

1. Can any of your Correspondents inform me of a cheap substitute for varnish, for preserving specimens of typography, drawings, &c. from being sullied by flies, smoke, dirt, and the like?—Z.

2. What is the best mode of preventing foul air from coming up through the water-pipes into the kitchens of our houses?—Z.

3. Could a plan be adopted, by applying a stopper to the waste-pipe, so constructed, that when the water rose to that height, the stopper would be opened, to allow the water to escape, and when it fell, so that the stopper would shut of its own accord?—Z.

SCIENTIFIC INTELLIGENCE.

Mr. Perkins's Steam-Guns.—The great power of Mr. Perkins's engine he has recently illustrated by some singular experiments. He has constructed a small apparatus, which, when connected with the generator, has been found to discharge ordinary musket-bullets at the rate of 240 in the minute, and with such tremendous force, that after passing through an inch deal, the ball, in striking against an iron target, became flattened on one side, and squeezed out. The original size of the bullets was 0.65 of an inch, but after striking the target, they were plano-convex, and their diameter 1.070 inches, and 0.29 of an inch thick.

On the Nature of the Atmosphere of Seas.—In a curious paper on this subject, M. Vogel, of Munich, has given the following results. 1st. That the air of the Channel, between Dieppe and Havre, contains muriates. 2d. That the air of the Channel, as well as the air of the Baltic, contains a less quantity of carbonic acid than the air of the Continent. 3d. That the muriates do not disengage there acid, at a temperature capable of bringing them to ebullition, but that they are partly volatilised with the vapours of the water. 4th. That there is no particular colouring principle in sea air, as M. Hermbstaedt of Berlin thought; and that the red colour produced by nitrate of silver with the aid of the sun, is due rather to the muriates. 5th. That all water whatever, which contains traces of a muriate, possesses the property of acquiring a wine-red colour,

with nitrate of silver, when exposed to the sun.

Ancient Inscriptions on Sheets of Lead.—Prior to the invasion of Spain by the French armies, sheets of lead, inscribed with characters approaching the Arabic, were found rolled up, and concealed in fissures of rocks near the city of Grenada. The discovery of these relics of antiquity arose from the accidental circumstance of a quarry having been formed on the spot. It was not doubted but that these deposites were made by the Moors, previous to there expulsion from Spain, which took place about the year 1491.

ON THE IDENTITY OF NEWTON'S RULE,

For Reducing Equations, with that of G. F.

"He that's convinced against his will,
Is of the same opinion still."

For the satisfaction of some of our Readers and Correspondents, we have been led to give a demonstration of the identity of the two rules for reducing equations, given at page 63, Vol. II. Let the two following equations be reduced into one, by the elimination of the unknown quantity x.

$$x^3 + y^3 = a, \quad (1)$$
$$x^4 + y^4 = b, \quad (2)$$

By Newton's Rule.

Multiplying the 1st equation by x, and transposing, gives

$$x^4 = (a - y^3)\, x; \quad (3)$$

Transposing the 2d equation, gives

$$x^4 = b - y^4; \quad (4)$$

Putting the 3d equation equal to the 4th, gives

$$(a - y^3)\, x = b - y^4; \quad (5)$$

Whence, by Division, we have

$$x = \frac{b - y^4}{a - y^3}; \quad (6)$$

Substituting this value of x in the 1st equation, and transposing, gives

$$\frac{(b - y^4)^3}{(a - y^3)^3} = a - y^3; \quad (7)$$

Whence, by Multiplication, we have

$$(b - y^4)^3 = (a - y^3)^4; \quad (8)$$

An equation from which the unknown quantity x has been eliminated.

By G. F.'s Rule.

Transposing the 1st given equation, and dividing, gives

$$x = \frac{a - y^3}{x^2}; \quad (3)$$

Transposing the 2d given equation, and dividing, gives

$$x = \frac{b - y^4}{x^3}; \quad (4)$$

Putting the 3d equation equal to the 14th, gives

$$\frac{a - y^3}{x^2} = \frac{b - y^4}{x^3}; \quad (5)$$

Whence, by Multiplication, we have

$$(a - y^3)\, x^3 = (b - y^4)\, x^2; \quad (6)$$

And, by dividing by x^2, we have

$$(a - y^3)\, x = b - y^4; \quad (7)$$

When, by Division, we have at last

$$x = \frac{b - y^4}{a - y^3}; \quad (8)$$

Again; putting the 3d equation equal to the 8th, gives

$$\frac{a - y^3}{x^2} = \frac{b - y^4}{a - y^3}; \quad (9)$$

Whence, by Multiplication, we have

$$(b - y^4)\, x^2 = (a - y^3)^2; \quad (10)$$

And, by Division, we obtain

$$x = \frac{(a - y^3)^2}{(b - y^4)\, x}; \quad (11)$$

Again; putting the 8th equation equal to the 11th, gives

$$\frac{b - y^4}{a - y^3} = \frac{(a - y^3)^2}{(b - y^4)\, x}; \quad (12)$$

Whence, by Multiplication, we have

$$(b - y^4)^2\, x = (a - y^3)^3; \quad (13)$$

And, by Division, we obtain

$$x = \frac{(a - y^3)^3}{(b - y^4)^2}; \quad (14)$$

Again; putting the 8th equation equal to the 14th, gives

$$\frac{b - y^4}{a - y^3} = \frac{(a - y^3)^3}{(b - y^4)^2}; \quad (15)$$

Whence, by Multiplication, we have

$$(b - y^4)^3 = (a - y^3)^4; \quad (16)$$

An equation from which the unknown quantity x has been eliminated.

In this example, it is evident, that the number of steps necessary to eliminate the unknown quantity by G. F.'s Rule, are more than double the number necessary by Newton's Rule. Moreover, the two rules are perfectly identical, and the one is merely a modification of the other. This will be obvious, by comparing the different steps of the one with those of the other. The 3d and

4th of Newton's are the same as the 3d and 4th of G. F.'s; only in the latter the likeness is concealed by putting all the powers of the unknown quantity, except one, under the right-hand members of the equations, for denominators. Hence it is obvious, that the 5th and 6th of Newton's are *exactly* the same as the 7th and 8th of G. F.'s, and that the former were more easily obtained than the latter, without the intervention of other two steps; which, however, only conceal the same equations under a different form. The 7th and 8th of Newton's are precisely the same as, and tantamount to, the numerous steps of G. F.'s, from the 9th to the 16th inclusive. The reason of this is, that by Newton's mode, the quantities are raised to the necessary powers at once by substitution *per saltem;* while, by G. F.'s the substitution is made by the slow *hop and step* process. Thus, his 9th step, by only putting the single independent value of x, equal to its value in the 3d equation, raises the other quantities to the 1st requisite power, the equation involving still the square of the quantity to be eliminated, as in the 11th.

Again, in the 12th, by putting the single independent value of x, equal to its value in this involved equation, (which, like Mahomet's coffin, hangs between the known and the unknown,) the other quantities are raised to the second requisite power, the equation having now got only the first power of the quantity to be eliminated it, as in the 14th.

Lastly, in the 15th, by putting the single independent value of x, equal to its value in this new involved equation, the other quantities are raised to the third requisite power, the equation having now at last got rid of the quantity to be eliminated, as in the 15th, which, by mulplication, coincides exactly, in the 16th, with Newton's 8th.

In the same manner, it may be shown that in all such equations, according to G. F.'s plan, it is necessary to go through not only as many steps to obtain the final equation, as are denoted by the power to which the eliminated quantity ought to be raised in that equation, where its least power is contained, but a great many more, if we reckon the number of substitutions that are required. But it is obvious, from what we have shown above, that these substitutions are merely necessary to obtain the powers of the values of the eliminated quantity, which can, by Newton's mode, be obtained at once.

In this respect, therefore, his rule is like the common rule for obtaining the powers of a quantity by continual multiplication, while a much shorter and easier mode is presented by the Binomical Theorem. As to the first part of his rule for obtaining a value of the eliminated quantity in terms of the rest, it also coincides with Newton's, as we have shown, and is liable to the same objection, namely, that of obtaining by a number of steps what can be obtained at once. Were we to take the general equations

$$x^n + y^n = a,$$
$$x^{n+1} + y^{n+1} = b,$$

it might be easily shown, generally, that the two rules are identical, and that Newton's has the preference; because a general formula for solution can be obtained by his mode, which cannot be by any means obtained by G. F.'s mode. For, in order to show that his mode does not branch out into infinity, it is necessary to assume the value of n, otherwise a solution cannot be obtained.—The reason of this is, that in eliminating the quantity x, after having obtained an independent value, the powers become x^{n-1}, x^{n-2}, x^{n-3}, &c. to infinity.

The same conclusions to which we have arrived might be shown of much more complicated equations, and even generally, were these disquisitions suited to the nature of our work; but, as they are not, we must decline the discussion without any intention of ever resuming it again. We have thought it necessary thus to vindicate ourselves from the violent aspersions of an obscure and anonymous writer, merely because some of our friends were apt to attach more value to his lucubrations than they deserved.—We believe that now they will be fully convinced of the futility of his pretensions to a discovery, which, had it really been one, could never have escaped the glance of those acute analysts, who have laboured since the days of Newton in this department of Algebra, but which must have been abandoned, because it presented not only no superiority over the common Newtonian rule, but was only a variation of that rule, unworthy of general adoption.

GLASGOW MECHANICS' INSTITUTION.

THE exertions and success of this Institution have been highly creditable to the taste and the character of the Mechanics of Glasgow, and have, in a great measure, contributed to the cultivation of habits, which must eventually raise the condition of the whole body of the operative class of the community. But however creditable these exertions have been, both the infant state of the Institution, and the utility of its objects, point it out as deserving the support of the more opulent members of society. It is therefore with pleasure we learn that subscriptions have been opened, for the purpose of assisting the Institution in procuring books and apparatus. Many liberal subscriptions of this kind have been made for similar Institutions in other places; and, we are sure, that Glasgow, the first, in every other respect, in showing an example, will not be behind in the present instance.

The following subscriptions have already been received.

James Finlay & Co.	£21	0	0
Claud Girdwood & Co.	10	10	0
James Ewing	5	5	0
William Dunn	5	5	0
R. Dalglish, Falconer & Co.	5	5	0
Charles Macintosh	5	5	0
John Bartholomew & Co.	£5	5	0
William Smith	2	2	0
William Snell	2	2	0
John Alston	2	2	0
William Rodgers	2	2	0
Robert Graham	2	2	0
James Stevenson	2	2	0
R. J. M'Haffie	2	2	0
Thomas Harvie	2	2	0
C. S. Parker	2	2	0
Peter Hutchison	2	2	0
James Dunlop & Son	2	2	0
Michael Rowand	2	2	0
William Mitchell	1	1	0
Alexander Garden	1	1	0
James Lumsden	1	1	0
Nathaniel Stevenson	1	1	0
R. D. Alston	1	1	0
William Hunter	1	1	0
John Thomson	1	1	0
Samuel Hunter	1	1	0
William Hamilton	1	1	0
Alexander Campbell, jun.	1	1	0
John Buchanan	1	1	0
William Kelly	1	1	0
Glasgow Free Press	1	1	0
William Black	1	1	0
James Buchanan	0	10	6
David Laird	0	10	6
John Graham	0	10	6

GLASGOW LITERATURE.

WE are happy to announce to our readers that a new periodical, devoted to General Literature, is about to make its appearance, under the auspices of our worthy Publisher. Sincerely do we wish it success, as we are well aware that, in this populous and enlightened City, notwithstanding the taunts of its neighbours and the pretended confessions of some of its unworthy sons, there is a vast field for useful exertion in the various branches of elegant learning and the Fine Arts, and that there are not a few whose taste and abilities will lead them to support and encourage, by their example and assistance, an undertaking from which much good may justly be expected to flow through all classes of the community. We trust that the more splendid efforts, which we are led to expect from the conductors and contributors to this new work, joined to our own humbler (and hitherto successful) labours in the diffusion of useful knowledge, will ultimately be productive of the happiest effects, not only in the amelioration of the condition of that portion of the race who dwell in this highly favoured land, but also in the production of a degree of perfectibility in this sublunary state, which shall even surpass the most sanguine expectations of the speculative philosopher, or the more praise-worthy philanthropist.

NOTICES TO CORRESPONDENTS.

W. R., D. A. N, and T., will be inserted next week.—Ecod under consideration.—Niger may now, with the greatest propriety, add *Diabolus*, in *propria persona*, to his other titles; he *dare not*, however, appear in the place he mentioned, in the human form he has assumed.

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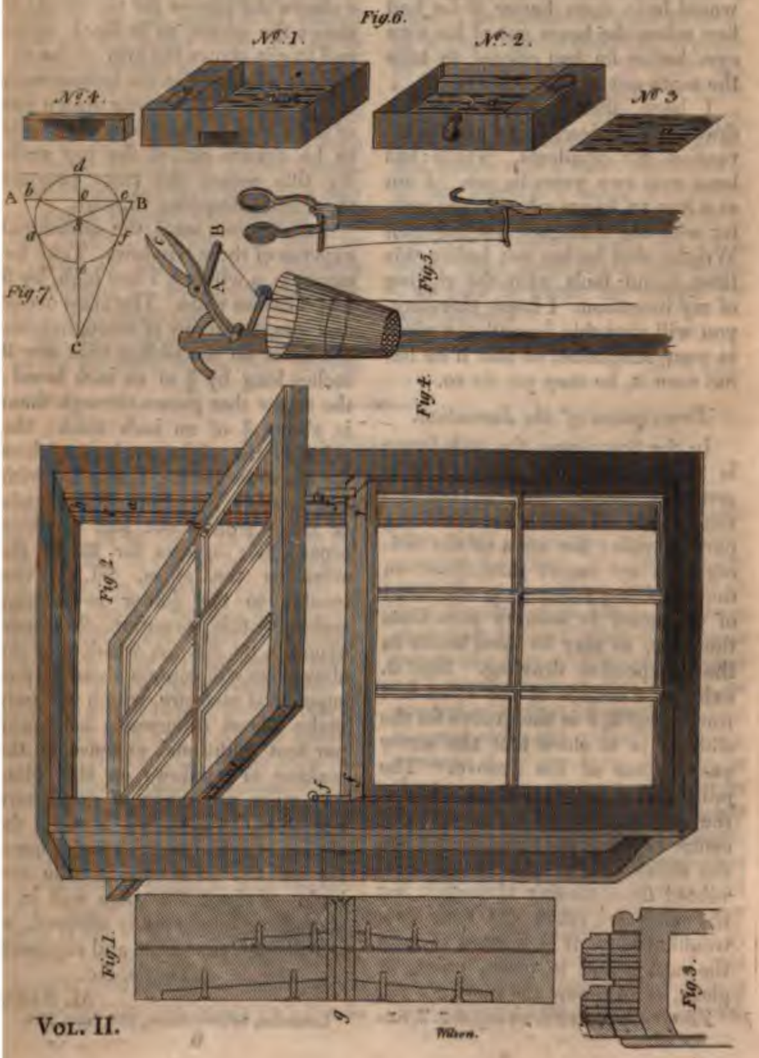
THE GLASGOW
MECHANICS' MAGAZINE.

" Man is the minister and interpreter of nature."—*Bacon.*

No. XXXVII. *Saturday, 11th September*, 1824. Price 3*d.*

Mr. SAUL'S REVOLVING WINDOW.—Messrs. LANE AND SAUL'S FRUIT-GATHERERS.—Mr. ALLAN'S BEE-FEEDING BOX.



REVOLVING WINDOW.

Lately Invented by Mr. Saul of Lancaster.

Sir,—In No. XIV. page 250, Vol. I. of your very useful Magazine, I observe a communication from a person signing himself "A Journeyman Wright," purporting to be objections to the Improved Window, invented by Mr. Johnson. I think the Journeyman Wright would have done better if he had first taken the beam out of his own eye, before he had offered to take the mote out of Mr. J.'s eye.

I have, therefore, sent you a drawing and description of my invention for windows, which has been now two years in use. I am at a loss to know what is the matter with the Glasgow Journeyman Wright, that he has not before this time found fault with the rigging of my invention. I hope, therefore, you will give this invention a place in your Magazine, so that if he has not seen it, he may yet do so.

Description of the Invention.

In the first place, the sash-frame is made nearly the same as it is generally made. Fig. 1. exhibits the manner in which the revolving part is made; the arms on the sliding stile are longer than those on the revolving stile; at *g* the head of the screw is seen to pass from the edge, as may be seen better in the perspective drawing. Fig. 3. exhibits a section of the stiles and frame; fig. 2, *b* is the groove for the slide, *c* is to show that the screw passes clear of the groove. The joint of the stiles is seen just clear of the casing, and passes through the centre of the groove; so that when the slides are in, the rain is prevented from coming through; but the slides are taken out with little trouble, when it is wanted to turn the sash round to clean, paint, or glaze, or to renew the lines.

The perspective drawing, fig. 2, exhibits the upper sash open; at *a* it shows that the line can be renewed without taking the sash out of the frame, by drawing the sash down, and passing the cord down behind *b*, to *a*; you then draw the end through, make a note and press it into the hole again, and there make it fast; *c* shows the groove for the slide; *d* shows the screw, as in fig. 1, at *g*; and at *e* it shows the arm of the revolving stile, at *f* in the bottom sash it shows the slides partly drawn out of the slides. The slides are made to be drawn out of the top sash. By this means the rings prevent them from dropping through.

I shall now state the additional expense of these windows. Take for example, a window 7 feet high, by 3 feet 6 inches wide. The arms are of cast iron, the screw of wrought iron, the arms on the sliding stile are 9 inches long by $\frac{3}{4}$ of an inch broad; the screw that passes through them is about $\frac{3}{8}$ of an inch thick; the price of the eight castings of iron for the arms is 1s.; fitting up with four screws, 3s.; four slides made of sheet iron about half an inch broad, 2s.; screws for fixing the arms to the stiles, 3d.; extra trouble to the joiner in making sashes to this invention, 2s.; total expense, 8s. 3d. A window of the above size will contain about 28 feet superficial measure, which will only make about threepence halfpenny per foot additional expense in the making of windows on this plan. My stiles are made of good hard red deal, two inches broad; the sliding stile is one inch and a quarter thick; the revolving stile one inch. I hope this plan will in a short time be generally adopted, as it will both save lives and expenses.

Your's, &c.

M. Saul.

Lancaster, Sulyard-Street, 12th June, 1824.

FRUIT GATHERERS.

Invented by Mr. LANE of Stockwell, and Mr. SAUL of Lancaster.

THIS is an invention by which fruit can be taken either from wall trees or standards, without breaking the branches, with the greatest ease. Fig. 5. is Mr. Lane's invention. It consists of a pole ten or twelve feet long, so as to reach the fruit; at the end of the pole is fixed a pair of forceps, for the purpose of taking hold of the fruit; these are made to open and shut by means of a trigger at the lower end of the pole, which is connected to the moving forcep, by a wire passing through a groove in the pole to the forcep. The forceps are each made of a ring of metal, covered and padded with soft leather, forming two cups to receive the fruit, without pressing or bruising it; by which means the fruit is brought down.

Mr. Saul's invention, fig. 4, is made to cut the stalk of the fruit, instead of pulling it off. By this invention a whole bunch of cherries may be cut, or only one at a time, just as they are wanted; for being ripe, and as soon as the stalk is cut, it is received into a basket below, fixed for the purpose. By Mr. Lane's invention only one can be taken down at a time. The cutters are made to move on a joint, and a quadrant is made to set the cutters to suit the branches; a small spring is fixed at A, to keep the cutters open; a small cord is fixed to the arm at B, and passes over a small wheel down to the operator's hand, who pulls when the stalk is in the cutter at *c*. By this invention, fruit has been taken from trees thirty feet high. The pole is made any length by joint screws.

Your's, &c.

M. SAUL.

BEE-FEEDING BOX.

Invented by Mr. JOHN ALLAN of Pennycuik.

No. 1, Fig. 6, is a box of hardwood or deal, to be tight, to keep in the liquid that is put in for feeding.—The box is about 9 inches by 4, and 2½ inches deep. There is a bench left in the inside of the front of No. 1, tight to the inside front, having only a piece cut slanting to the top of the bench, seen at No. 4, about an inch and a quarter square. The slope is cut out to the front entry, where the bees are admitted to go over the bench to the float *a*, below which the food is: the bees feed through the slits or holes. No. 3 is the float *a*, separate from the box; it is made of light deal. The inside of the front of No. 1, with the bench and part of the entry for the bees, is seen over the bench by which the bees enter the hollow part No. 4, and get down to the float *a*, where they walk about and feed without wetting their feet. No. 2 is the back part of No. 1, where the cover is over the hole that lets in any bees that may be out, after the box is put to the hive. The cover moves on a screw nail, so that it can be opened or shut at pleasure. There is some cloth put round the entry to make it fit the hive, to keep in the right bees, or keep out strange bees. There is glass put on the top of the box, by sliding it in a groove, to keep the bees in, and warm; but if you want to give more food to the bees without taking away the box, take a sliding cover at 6, and pour in the provisions; it goes down the hole, communicates by a slit below the float, raises up the float,

and supplies the wants required. Then shut the slide to prevent strange bees from partaking of the food from the hole. When I begin to feed, it is generally after the bees have given over for the day. I give but little honey at a time in the spring, but when feeding I make up the deficiency in the fall. I can feed them at any time. In winter if the sun is warm in the middle of the day, I feed them; but if necessity requires it, I take them into the house where there is heat, and feed them through the night. At first the bees are very shy to come to these provisions; but, after tasting the honey, a tap or two after the boxes are put to the hive, they will suddenly rush into the box, feed, and go away with their load, and return in a few minutes for another load. It is very pleasant to see them feeding through the glass, and going in and out. Sometimes they crowd the box too much; when that is the case, pull the box a little back from the entry to give them air and more room; but a little practice will overcome all difficulties. I have practised feeding bees for upwards of twenty years, with the boxes of different kinds, but the above I found to answer far better than any I ever tried. The above is the common size, I have made them from 5s. to 10s. 6d.; but any person may make them by the above description. I have given my bees one pound or more of honey at a time, and found the whole done by next morning. One hive which I have this year, was, last fall, only about twelve pounds weight. I fed through the winter, and lost but very few bees, and at this day it is ready for swarming. I make some of the feeding boxes with three stories, and put in pieces of broken corn, &c. in the different apartments with which the bees have communication from the main entry, but this is only required in the back part of the year, to make up weak hives.

Your's, &c.

JOHN ALLAN.

Pennycuik, 15th June, 1824.

ON THE USE OF POTATOES INSTEAD OF SOAP, IN WASHING LINEN.

IT is a recently announced fact, that an ink-stain, which the laundress had long thought to be indelible, is instantly removed, by means of an atom of dry soap properly applied. This verifies the old proverb, that "It is the manner of doing a thing that does it." This experiment furnished an idea, that ninety-five pounds of soap in the hundred might be saved by using dried soap generally for washing. Science is generally the friend of economy. It is now found possible to banish all the substances used in washing, namely, wood-ashes, potash, soda, and even soap! The use of these substances, so troublesome, hurtful, and expensive, may be wholly superseded by *potatoes only three-parts boiled.*

This experiment was made at a washing establishment in France, where some improvement was much needed. There, in addition to the use of soap and other substances, they employ a rough brush, and a battledore or flat piece of wood to beat the clothes, besides washing machines. The result of these operations is, that shirts are worn out and reduced to rags, after being washed only about thirty times. Often have we been surprised to see the females beating their linen clothes on the benches in the float-

ing machines on the Seine, between the Pont Neuf and the Pont des Beaux Arts, and the result is only what we anticipated from the operation.

The experiment was made, by washing body and house linen, &c. with potatoes only three-parts boiled, instead of soap, or the alkalies—salt, lime, &c.—generally used. The linen clothes, consisting of shirts, sheets, coverlets, table-linen, towels, brewers' aprons, hospital-linen, &c. were first thrown into a tub, to soak in water for about an hour. They were then put in a copper of hot water, from which they were taken separately, and thoroughly rubbed with potatoes, the same as with soap. The whole thus prepared, after being well rubbed, rolled, and wrung, were a second time thrown into the copper, together with a quantity of potatoes in the aforementioned state.

After boiling for about half an hour, the clothes were again taken out; then turned, thoroughly rubbed all over, and wrung; and then thrown into the copper again for some minutes. They were next well rinsed, in a large quantity of water, twice over, and then allowed to remain for half an hour in cold water. They were, lastly, put into a press to drain, and then hung up to dry. The time occupied by these different processes, was about two hours and a half. The linen thus washed was perfectly clean, free from all grease, and looked very white. Even the kitchen linen, which generally retains a greasy smell, whatever means be employed to clean it, was after this process perfectly sweet.

ON UNEQUAL-ARMED BALANCES.

Though the writers on balances require, and are very solicitous to procure, a perfect equality in the arms, yet as this equality is exceedingly difficult, if not impossible, to be obtained, so neither does it appear anywise necessary to the accuracy of the instrument. If ten equal weights, put into one scale, are counterpoised by a weight in the other; and if the ten weights be then removed, and a piece of silver or brass plate put in their room—it is evident, that, when this plate shall be made to balance the counterpoise, it will be exactly equal in weight to those ten weights, however unequal the arms of the balance may be; and consequently, that "any unequal-armed balance, may, on this principle, have a set of weights adjusted to it; which being used always in one scale, the instrument shall be of the same accuracy as if the arms were most exactly equal."

The best way of procuring small equal weights for nice experiments, is by cutting equal lengths of the finest silver wire. The silver thread, kept equally stretched by a heavy body at the end, may be coiled close round a thicker piece of brass wire, and all the coils be cut through at once, by a sharp instrument applied lengthwise. "Silver-wire is drawn to such extreme fineness, and of such a uniform thickness. that weights thus made by mensuration, are of greater nicety than it is possible for any balance to weigh." A piece of the wire, whose length is very sensible, and much farther divisible, shall not have sufficient weight to give any sensible motion to the most delicate balance. These small pieces, such as will just move the balance when empty, and which, consequently, will not move it at all when loaded, are a very useful appendage to the adjusted series of weights.

Though a balance appears exactly in equilibrio, yet one side may really preponderate by any quantity of force, less than that which is sufficient to overcome the friction on the centre; as less additional weight will serve to depress this side than the other. One of the small weights, tried first in the one and then in the other scale, will enable us to judge whether the equipoise is exact, or on which the preponderation lies.

W. L.

ON COPPER SOLDERS.

There are two kinds of solders for copper, one for *hard*, and the other for *soft* soldering. The *hard solder* is made with eight parts of copper, and one part of zinc. The copper is first melted in a crucible, and during the operation the zinc is also heated. When the copper is melted, the zinc is thrown hot into it; the crucible is then covered, and the whole well shaken together. In two or three minutes, the metal is poured out, through the twigs of a birch broom, placed over a proper vessel filled with water. By this process, the metal is divided into small grains, after which it is well washed and kept for use. This solder is very fusible, as well as malleable.

A good solder may be made of an alloy, composed of three parts of copper and one of zinc. In general, the solder is harder or softer, according to the quantity of copper employed. The more copper is used, the harder is the solder, but less fusible. The highest degree of hardness is produced, when ten parts of copper are united with one part of zinc, but it is the least fusible. Solders of various degrees of fusible power are often necessary, especially when several pieces are to be soldered to each other. The *least* fusible solder is first used, and and the others in succession, according to the number of pieces to be soldered. By this means, the first soldered pieces are not affected by the degree of heat necessary to join the rest.

Soft solder is a mixture of two parts of tin and one of lead, poured into ingot moulds. It is used with a hot iron, as plumbers and tinsmiths use it.

P. T.

ON RECKONING TIME.

Sir,—There is a question connected with Geography, on which I have disagreed with many people. It is concerning the difference that there is in reckoning time, between the people who live under different meridians, in consequence of the Sun's coming to those meridians at different times. It is maintained, by some, that there can be no more than twelve hours, between any two places of the world, at the same time. Now, I maintain that there must be much more than twelve hours, between some places and others. The inhabitants of London, those of Botany Bay, and those of Washington, cannot all reckon time within twelve hours of each other. If those of Botany Bay reckon it ten hours before those of London, and if those of London reckon it five hours before those of Washington, then will those of Botany Bay reckon it fifteen hours before those of Washington. When

it is Sunday mid-day at London, it will be Sunday night, ten o'clock, at Botany Bay, and Sunday morning, seven o'clock, at Washington. Upon the same principle, supposing that there were people under every meridian round the world, and supposing that they were all agreed to reckon time, as nearly in the same manner as possible, the inhabitants of some places must reckon it nearly twenty-four hours earlier than those of some other places; and those people who differed so much in their reckoning of time, would live nearly under the same meridian. Those fifteen degrees to the West of this meridian, would reckon it twenty-two hours earlier than those fifteen degrees to the East of it: those thirty degrees to the West of it, would reckon twenty hours earlier than those thirty degrees to the East of it, and so on round the world. This theory I hold to be as incontrovertible as any self-evident proposition. By many, I doubt not, the truth of it will be admitted at once; but by many others it has been held to be absurd; and the Editor of a certain periodical work said that the falsity of the theory was evident.

It does not appear, by this theory, that there are places whose inhabitants differ twenty-fours in reckoning time; but only that if there were people under every meridian round the world, who all agreed to reckon it as nearly in the same manner as possible, some of them must reckon it nearly twenty-four hours earlier than others. If there be not, in reality, some people who differ nearly twenty-four hours from others, I think it must be either because there is some vast portion of the globe, under whose meridians, from pole to pole, there are no inhabitants to reckon any thing about time; or because, if there be inhabitants, their manner of reckoning time is so dissimilar to that of the inhabitants of the world in general, that they cannot be taken into the account: and the number of degrees of longitude contained in this portion of the globe, is exactly proportioned to what the greatest difference in reckoning time wants of twenty-four hours. I would like if any of those, who hold that there can be no more than twelve hours between any two places of the world, would tell me what day and hour it is at Botany Bay, and what day and hour it is at Washington, at that instant of time when it is Sunday mid-day at London?

In considering this question, the particular days, as well as the particular hours and places, which may be fixed on for the purpose of illustrating it, must be always kept in view. I believe it is much owing to want of attention to this rule, that the subject is not more generally understood.

I am, SIR, your's, &c.

T.

Glasgow, 1st September, 1824.

CUBE ROOT QUERY SOLVED.

(See page 25, Vol. II.)

PROBLEM.—How to tell immediately, without the pen, the cube root of any number containing six figures, when only three of them are given, namely, the units' figure, and the figures in the places of tens of thousands, and hundreds of thousands.

It is well enough known that the cube root of such a number must consist of two places only, namely, units and tens. Now, the first two

figures of the number on the left hand are given, which are sufficient to determine the tens of the root; and the unit figure of this number is sufficient to determine the units of the root. Annex a cipher in the mind to the first two figures of the number; find the nearest cube root of these three figures, and it will be the tens of the root. The units of the root will be found from the units of the number, by remembering that the cubes of 1, 4, 5, 6, and 9, terminate in 1, 4, 5, 6, and 9, respectively, and that the cubes of 2, 3, 7, and 8, terminate in 8, 7, 3, and 2, respectively. Thus, in the example proposed by J. D. E., the figures stand thus, 43 . . . 6. Now, by annexing 0 to 43, it becomes 430, and the nearest cube to 430, is 343, the root of which is 7, or the tens of the root. The unit figure of the number being 6, the unit figure of the root will also be 6. Hence, 76 is the root required. The proof of this is, that $76 \times 76 \times 76 = 438976$, the complete number. It is, perhaps, unnecessary to state, that the solver of the query, without the pen, must have in his memory the cubes of the nine digits. We hope that J. F. will no longer consider J. D. E. a *Conjuror*.

TABLE OF THE WEATHER, FROM Dr. HERSCHELL'S OBSERVATIONS.

Sir,—The following Table is from observations taken by the late celebrated Dr. Herschell, concerning the weather. I found it to be pretty correct during the summer and autumn of 1823. The present season being so very fine, I paid but little attention to it, but it may be of use to some of your readers.

I am, Sir,

Your obedient Servant,

M. A.

3d Sept. 1824.

Time of New or Full Moon, or of entering the First Quarter.		Weather likely to follow during the Quarter. In Summer.	In Winter.
12 Noon, to	2 P.M.	Very Rainy, ...	Snow or Rain.
2 P.M. to	4 —	Changeable, ...	Fair and Mild.
4 — to	6 —	Fair, ...	Fair.
6 — to	10 —	Fair, if Wind N. W. ...... Rain, if Wind S. or S. W.	Fair, Frosty if Wind N. or N. E. Rain or Snow, if Wind S. or S. W.
10 — to	12 Midnight,	Fair, ...	Fair and Frosty.
12 Midnight, to	2 A.M.	Fair, ...	Hard Frost, unless Wind S. or W.
2 A.M. to	4 —	Cold, with Showers, ...	Snow and Stormy.
4 — to	6 —	Rain, ...	Snow and Stormy.
6 — to	8 —	Wind and Rain, ...	Stormy.
8 — to	10 —	Changeable, ...	Cold, Rain if Wind W. Snow, if Wind E.
10 — to	12 Noon,	Frequent Showers, ...	Cold, with high Winds.

ON THE ATMOSPHERE.

[We have great pleasure in laying before our readers, the following extract from a very able and original work, entitled, "Meteorological Observations," by J. F. Daniel, F. R. S. It contains the results of some very elaborate inqui-

ries into the nature of the atmosphere, with which the author has been engaged for many years; these results are the more interesting, as they serve to throw light on some inquiries connected with the origin of the globe, a subject which we are happy to observe, he has treated in a manner highly creditable to himself, and useful to those whose minds are apt to be led astray by the sneers of philosophers, or the scoffs of infidels.]

There are two distinct atmospheres, mechanically mixed, surrounding the earth; whose relations to heat are different, and whose states of equilibrium, considering them as enveloping a sphere of unequal temperature, are incompatible with each other. The first is a permanently-elastic fluid, expansible in an arithmetical progression by equal increments of heat, decreasing in density and temperature according to fixed ratios, as it recedes from the surface, and whose equipoise under such circumstances, would be maintained by a regular system of antagonist currents. The second is an elastic fluid, condensible by cold with evolution of caloric; increasing in force in geometrical progression with equal augmentations of temperature; permeating the former and moving in its interstices, as a spring of water flows through a sand-rock. When in a state of motion this intestine filtration is retarded by the *inertia* of the gaseous medium, but in a state of rest the particles press only upon those of their own kind. The density and temperature of this fluid have a tendency likewise to decrease, as its distance from the surface augments; but by a less rapid rate than that of the former. Its equipoise would be maintained by the adaptation of the upper parts of the medium, in which it moves, to the progression of its temperature, and by a current flowing from the hotter parts of the globe to the colder. Constant evaporation on the line of greatest heat and unceasing precipitation, at every other situation would be the necessary accompaniments of this balance. Now the conditions of these two states of equilibrium, to which, by the laws of Hydrostatics, each fluid must be perpetually pressing, are essentially opposed to each other. The vapour or condensible elastic fluid is forced to ascend in a medium, whose heat decreases much more rapidly than its own natural rate; and it is therefore condensed and precipitated in the upper regions. Its latent caloric is evolved by the condensation, and communicated to the air; and it thus tends to equalize the temperature of the medium in which it moves, and to constrain it to its own law. This process must evidently disturb the equilibrium of the permanently-elastic fluid, by interfering with that definite state of temperature and density which is essential to its maintenance. The system of currents is unequally affected by the unequal expansion; and the irregularity is extended, by their influence, much beyond the sphere of the primary disturbance. The decrease of this elasticity above, is accompanied by an extremely important re-action upon the body of vapour itself; being forced to accommodate itself to the circumstances of the medium in which it moves, its own law of density can only be maintained by a corresponding decrease of force below the point of condensation: so that the temperature of the air, at the surface of the globe, is far from the term of saturation; and the current of vapour, which moves from the hottest to the coldest points, penetrates from the equator to the poles, without producing that condensation in mass, which would otherwise cloud the whole depth of the atmosphere with precipitating moisture. The clouds are thereby confined to parallel horizontal planes, with intermediate clear spaces, and, thus arranged, are offered to the influence of the sun, which dissipates their accumulations and greatly extends the expansive power of the elastic vapour. The power of each fluid being in proportion to its elasticity, that of the vapour compared with the air, can never, at most, exceed 1 : 30 : so that the general character of the mixed atmosphere is derived from the latter; which, in its irresistible motions must hurry the former along with it. The influence, however, of the vapour upon the air, though slower in its action, is sure in its effects, and the gradual and silent processes of evaporation and precipitation govern the boisterous power of the winds. By the irresistible force of expansion unequally applied, they give rise to undulations in the elastic fluid; the returning waves dissipate the local influence, and the accumulated effect is annihilated, again to be reproduced.

In tracing the harmonious results of such discordant operations, it is impossible not to pause, to offer up a humble tribute of admiration of the designs of a

beneficent Providence, thus imperfectly developed in a department of creation where they have been supposed to be the most obscure. By an invisible, but ever-active agency, the waters of the deep are raised into the air, whence their distribution follows, as it were by measure and weight, in proportion to the beneficial effects which they are calculated to produce. By gradual, but almost insensible expansions, the equipoised currents of the atmosphere are disturbed, the stormy winds arise, and the waves of the sea are lifted up; and that stagnation of air and water is prevented which would be fatal to animal existence. But the force which operates, is calculated and proportioned: the very agent which causes the disturbance bears with it its own check; and the storm, as it vents its force, is itself setting the bounds of its own fury.

(To be concluded in our next.)

SUPPLEMENT TO MORRISON'S COMPENDIUM OF ARITHMETIC. By William Maver, Editor of the Improved Edition of Johnson's Dictionary, &c. &c. Hutcheson & Co. Glasgow, 1824. Pp. 24.

This is a very useful and necessary Supplement to Mr. Morrison's Book. It supplies the want of the usual rules found in larger works, under the names of Alligation, Arithmetical and Geometrical Progression, and Single and Double Position. The author has shown his ingenuity in subjoining some useful Algebraical and other notes at the bottom of the page, containing demonstrations of the rules given in the text. He has also subjoined to each of the rules a number of very ingenious and entertaining questions, from which we extract the following one for the amusement of our readers.

"If a Cardinal can pray a soul out of purgatory by himself in an hour, a Bishop in 3 hours, a Priest in 5 hours, and a Friar in 7 hours: in what time can they pray out $5\frac{1}{2}$ souls, all praying together?

Suppose 105 hours, the number arising from multiplying all their different times together; it is evident that a Cardinal could pray out 105 souls, a Bishop 35, a Priest 21, and a Friar 15 souls. The sum of all these is $105 + 35 + 21 + 15 = 176$. Then

souls, souls, hours, hours,
As 176 : $5\frac{1}{2}$: 105 : : 3 : 16′ . $52\frac{1}{2}$″ *Answer.*"

In conclusion, we may mention, that our Correspondent F. T., in our last Number, as well as others interested in his query respecting "The Roots of Equations," will find a complete answer to it in the note at p. 20, of this useful Supplement.

VARIOUS COMMUNICATIONS.

ON METALS.

Mr. Editor,—I was highly pleased to observe one of your Correspondents, Y., attempting to throw some new light on the subject of expansion. I beg your attention to one or two of his remarks; first, "there are very few metals so pure that they do not loose some weight in cooling, after having been heated red-hot, or melted." For my part I cannot conceive this; but I affirm, that it is while heating, or melting, that they lose weight, which the dross found in the furnace accounts for; for if it be so, as he affirms, a great many particles undoubtedly must fly from them while cooling, invisible to the naked eye.

I tried one experiment, by pouring two lbs. of melted iron into a pair of balances, and found it the same weight when cold as it was when melted. He likewise considers the expansion of iron far below the temperature of melted metals, which, in my opinion, is erroneous; for it actually takes place in a state of fusion. If a mould be made of founder's sand, to hold about a ton of metal, and the mould be so filled with the metal, in a very few minutes, by the cooling and consequent sinking of the mass, it will require more metal to keep it full, and this principle continues till the whole mass gets nearly hard. This shows how soon contraction begins; of course, it is evident that expansion must be quite the reverse. He likewise gives an example

of a needle swimming on water by the repulsion of its particles; and adds, "that the same repulsion will exist between melted and unmelted iron, even in a stronger degree." This example, however, affords but a faint resemblance of what takes place in metals; the fact is, if a piece of cold metal, without dross, be pressed down into melted iron, three or four feet below the surface, as soon as the pressure is taken away from it, it will immediately ascend to the top; now, if the repulsion exists in such a strong degree as he mentions, why will it not support a small piece of lead; for, if the melted iron were in a pot, and were emptied out, the lead would be found at the bottom.

With respect to J. C.'s query, Y. thinks he is under a mistake; but he should have tried the experiment to prove it so, before he said it. But, the fact is, Mr. Editor, that Y. is under a mistake himself, for steel actually will expand, when heated. I tried some bars of three different kinds of steel, and some of cast steel, each of which was a foot in length while cold, and on heating them at the common degree for hardening, and immersing them in water, each of the pieces of steel expanded about $\frac{1}{16}$ of an inch.

I am, Sir,
Your most obedient,
D. L. M'.

Johnstone, 13th May, 1824.

SOLUTION OF THE SPHERE QUERY.

Sir,—The following is a solution to the query proposed by "A Hamiltonian," at page 25, Vol. 11.

There are two cases of the problem, To find how much water would run over, were a heavy sphere, of a given diameter, dropt into a conical vessel, full of water, of a given diameter at the mouth, and of a given altitude?

Case 1st, Let the ratio of the diameter of the sphere, to the diameter of the conical vessel at the mouth, be the same with, or greater than, the ratio of the length of the slant side of the conical vessel, to its altitude. In this case, the sphere will be in contact with the conical vessel at its edge or lip, and the centre of the sphere will be above the surface of the water. The height of the centre of the sphere, above the surface of the water, is equal to the square root of the difference between the square of the radius of the sphere and the square of the semi-diameter of the conical vessel at the mouth. Whence the solid content of the spherical segment, immersed in the water, may be calculated.

Case 2d, Let the ratio of the diameter of the sphere, to the diameter of the conical vessel at the mouth, be less than the ratio of the length of the slant side of the conical vessel to its altitude. In this case, the sphere will not be in contact with the conical vessel at, but below, its edge or lip. The height of the centre of the sphere, above the *bottom* of the conical vessel, is equal to the rectangle contained by the length of the slant side of the conical vessel and the radius of the sphere, divided by the semi-diameter of the conical vessel at the mouth. To the height of the centre of the sphere above the bottom of the conical vessel, add the radius of the sphere, and, if the sum be greater than the altitude of the conical vessel, the sphere will be but partly immersed; and the excess of the sum above the altitude is the height of the highest point of the sphere above the surface of the water. Whence the solid content of the spherical segment, immersed in the water, may be calculated. But, if the sum be either equal to, or less than, the altitude of the conical vessel, the sphere will be wholly immersed.

The query of "A Hamiltonian" belongs to the 2d case of the problem.

Let A B C, fig. 7, be a conical vessel full of water. Its altitude $C\,o = 6$ inches, and its diameter A B, at the mouth $= 5$ inches. *a b d c f e*, a sphere, 4 inches in diameter, dropped into the vessel, A B C.

The length of the slant side of the conical vessel is equal to $\sqrt{A\,o^2 + C\,o^2} = \sqrt{2.5^2 + 6^2} = 6.5$ inches. The ratio of the diameter of the sphere to the diameter, A B, of the conical vessel at the mouth, will be found to be less than the ratio of the length of the slant side of the conical vessel, to its altitude. Therefore, the sphere will be in contact with the conical vessel at the points, *a*, *f*, *below* its edge or lip, as represented in the figure. Because the triangles $A\,o\,C$, $s\,a\,C$, are similar, $A\,o : a\,s :: A\,C : C\,s$. Hence, $C\,s = \frac{a\,s \times A\,C}{A\,o}$ that is $= \frac{2 \times 6.5}{2.5} = 5.2$ inches, the height of the centre of the sphere above the bot-

tom of the conical vessel. To this add the radius, sd, of the sphere; and, because their sum, $Cd = 7.2$ inches, is greater than the altitude of the conical vessel, therefore, the sphere is but partly immersed, and the excess ($od = 1.2$ inches) of their sum above the altitude, is the height of the highest point of the sphere above the surface of the water. Whence the solid content of the spherical segment, $baefc$, immersed in the water, may be calculated, and will be found to be 26.72215 cubic inches, nearly. It is evident, that there will run over a quantity of water equal in bulk to that portion of the sphere which is below the water's surface.

I am, SIR, your's, &c.

J. A. C.

Glasgow, 21st August, 1824.

[Similar solutions were given by J. A., L. D. L., and G. B.]

TO OBTAIN PHOSPHORUS.

PHOSPHORUS may be obtained by pouring acetate of lead into urine, mixing the white powder which precipitates with charcoal, and distilling it an earthen retort, by means of a violent heat. The beak of the retort ought to be plunged under water. The phosphorus drops into the water like melted wax.

W. R.

QUERIES.

SIR,—Can any of your numerous Correspondents furnish me with a practical *recipe* for good black marking ink for bales, boxes, and the like?—D. A. N.

Can any of your scientific Correspondents inform me of a mode of extracting foul air from working places below ground?—W. R.

SCIENTIFIC INTELLIGENCE.

CUTTING OF HARD STEEL BY SOFT IRON.

AT Newhaven, Connecticut, in America, this experiment has been performed in the most perfect manner. A wheel of soft and very thin plate iron, six inches in diameter, mounted on an axis, was made to revolve with such rapidity, that its motion became entirely imperceptible, and the wheel seemed to be at rest. Pieces of the best and hardest steel, such as files, and that used for gun-locks, being held against it, were cut through with a very great degree of rapidity; pieces of steel, as thick as the plate of a common joiner's saw, were cut almost as rapidly as wood is cut by the saw itself.

During the operation, there is a very vivid coruscation of sparks flying off in the direction of tangents to the edge of the wheel, and an intense ignition of the steel, extending considerably in the front, and on either side of the section. The pressure against the steel is so strong, that sometimes it is thrown against the opposite side of the room with great velocity. From this experiment, it appears, that none of the common operations on cold and hard steel, will cut it with so much rapidity as this method.

It is evident that this is only a particular method of cutting red-hot, or, perhaps, white-hot steel, as the mechanical force produces these degrees of heat; *and this is one of the best* modes of evolving heat by mechanical impulse. The steel, of course, loses its temper, at the place of section, but nowhere else; for the softening extends but a little way, and is limited to a narrow portion, marked by the iris colours, known to be produced by heat upon steel.

It appears that the iron-plate becomes only warm in the operation, and wears away very slowly; indeed, it does not seem to wear, for the edges are left rough; and the channel of section in the steel shows, with a magnifier, minute grooves, running in the direction of the revolution of the wheel. This philosophical experiment is highly interesting, and furnishes several points for solution. First, whether electrical phenomena are not produced in some peculiar manner; and, second, why the heat evolved by the impulse, is all nearly concentrated in the steel, and scarcely perceptible in the iron; also, why even ignited steel is so easily cut by the impinging of soft iron.

P. S.

Method of Preserving Animals for the Illustration of Natural History.—A very interesting lecture on the modes of stuffing and preserving animals, to resemble life, was delivered on the 8th January, before the *Leeds Philosophical and Literary Society*, by C. Waterton, Esq. We have been several times gratified by ranging through the Museum of this youth-

ful institution, and scarcely know how to express our admiration of the splendid and extensive collection of animals, and specimens of organic matter, which this Society possesses, through the liberality of its enlightened patrons. In viewing, however, the beautiful preparation for rare birds and beasts collected in this Museum, and which appear to be still endued with life, we have regretted, that in a very short space of time their colours would be faded, their beauty gone, and their furry coats or plumage moulder into dust. It must have been, therefore, peculiarly interesting to this Society, and will be gratifying also to every student and admirer of natural history to learn, that the means are now discovered of preserving from decay the very semblance of the living beasts and birds which inhabit the most distant regions of the globe.

Mr. Waterton (who has devoted much of his time to travelling, particularly in South America, and has acquired a very considerable collection of rare animals) commenced his lecture by expatiating upon the advantages which science and the arts obtain from extensive museums of natural history, but lamented that the modes hitherto practised, of preparing animal specimens, had not been found effectual in preserving them from the ravages of moths. Mr W. describes various experiments which he had made in the progress of his research, and at length the mode by which he had fortunately succeeded to his utmost wishes.

The chemical preparation employed was *alcohol* mixed in strong solution with *corrosive sublimate*, in which the skins of the beasts and feathers of birds were steeped; and the spirit being absorbed by all parts of the animal substance, carried the poisonous matter with it, which having saturated the skin and every fibre of the fur or feathers, totally precluded the possibility of any insect feeding upon it; as, of all poisons known, the corrosive sublimate is considered to be the most deadly to insects. The liquor being antiseptic, preserves the animal matter from decay, yet, being colourless, does not in the least injure the tint or texture of the most delicate specimen. Some of the specimens produced had been prepared in this way twelve years ago, and were seen to be still as beautiful and perfect as those recently killed.

The latter part of the lecture treated of the manner in which animals were usually stuffed with oakum or tow, by which they were made extremely heavy and ill-shapen, as well as inconvenient to remove; while, by his improved mode of stuffing, as was exemplified in the specimens exhibited, the anatomical character of the subject was accurately retained, and being made hollow, and capable of separating into parts, was light and conveniently portable.

For the purpose of dissection, a penknife and a hand not coarse and clumsy were required, and that was all: any man might learn the art in a week. In stuffing, it merely required cotton for the birds, and a piece of wood the size and shape of a knitting-needle. This was the mechanical apparatus. Mr. W. proceeded to give several important instructions as to the process of stuffing, and to expose the errors of the present system. He said, that the feathers ought to be kept close and smooth; that every bone should be taken out, to the very beak, instead of leaving in, as was usual, part of the skull; that wires should not be stuck into the birds, as neither their legs nor wings required it; that the orbits of their eyes, which usually increased in size from the shrinking of the surrounding skin, should be reduced to their natural size by a needle and thread, before the eyes were inserted. If the preparation was not made soon after the death of the animal, the legs would shrivel, and the parts most thickly covered with feathers would dry in disproportion to the others. It was not wonderful, then, that the specimens found in the most celebrated collections in Europe were all defective. The grand discovery, however, was the solution, alcohol and corrosive sublimate.—*Journal of Arts, &c.*

Perkins's Steam-Engine.—After all the endeavours which had been made to construct a generator, none had been produced, which would hold the steam under its great pressure, without very considerable leakage at the joints and rivets. This necessarily reduced the power which a perfect vessel would have been capable of exerting, and under these circumstances, Mr Perkins declined producing an imperfect experiment, which would have gone to the public as his ultimatum.

This difficulty is now removed, a generator having been at length produced, of wrought iron, without any seam or rivets, which has, we understand, been proved to sustain the enormous, and in-

credible pressure, *of twenty thousand pounds upon every inch of its surface.* This very extraordinary and unique piece of workmanship, has been made by Mr. James Russell of Wednesbury, and is considered by Mr. Perkins to have surmounted all his practical difficulties.

Nick of Time.—As a proof of how much may depend on the catching the exact moment of time, even in other occupations than that of the husbandman, we refer our readers to what happened a few years ago at Greenock, which circumstance has been a warning to the sailors ever since. The outward bound fleet of merchantmen had, as is frequently the case, been confined in the harbour for several weeks by contrary winds. In the middle of the night the wind shifted, and a brisk and favourable gale sprung up. As this change was altogether unlooked for at the time, the crews of most of the vessels were carousing on shore, or fast asleep in their hammocks—in fact, the crew of one vessel only were on the outlook at the time. They instantly weighed anchor—set all sail—got out of the harbour—doubled the point of land which had all along locked them in—and bore out for sea. In half an hour the wind shifted to its old quarter; but now they were more independent of it, because they had sea-room to tack against it. Not so with those vessels which did not embrace the opportunity: they remained as they were in their old station. The consequence was, that the ship which got out went to America, a distance of four thousand miles—discharged her cargo—got another on board—recrossed the Atlantic--came into Greenock--and found the rest of the fleet exactly where she left them. What a triumph was this to the active captain and crew, and what a disgrace to the others! Nor was this all. The captain who went to America, from his having been the only one who carried goods to the market, had it in his power to ask his own price for them, and, as there was no competition, he got it. Besides, as there were no other captains to compete with him in the purchase of his returning cargo, he also purchased it at his own terms; and, by these double advantages, enriched his employers.—*Duty and Advantage of Early Rising.*

Method of preserving Preparations.—Mr. W. Cooke of London, has found, that all preparations of animal bodies may be preserved by a solution of muriate of soda or common salt. He finds, that if used *a little below saturation*, it will preserve animal substances for an indefinite period, at all the temperatures of our atmosphere.

REPORT OF THE
GLASGOW MECHANICS' INSTITUTION,

(*Read at the General Meeting of the Members, held 4th September,* 1824.)

On Saturday evening, the 4th current, pursuant to Advertisement, a very full Meeting of the Members of the Glasgow Mechanics' Institution, was held in their Hall, for the purpose of electing a Lecturer on Chemistry and Mechanics for the ensuing Session.

At a quarter past eight, at least 600 Members must have been present, when the Committee of Management entered, and the Chair was taken amid cordial applause. After a few observations from the President Mr. Watson, Mr. H. Barclay read the following brief but satisfactory report of the proceedings of his coadjutors since last they met with their constituents. It was warmly received, and its adoption and approval unanimously carried.

REPORT.

"Before entering upon the important subject, which is the more immediate object of this Meeting, the Committee beg leave to allude to two circumstances of a very gratifying description respecting the prosperity of this Institution.

It will be recollected, that at the last General Meeting of the Members, a motion was made and carried, that the Committee should be authorised to borrow to the extent of £150, for the purpose of procuring Apparatus. It will also be recollected, that the propriety of this measure was at the time much questioned.

The Committee, therefore, anxious to take no step which might not meet with the cordial consent of all the Mem-

bers, and recollecting that a considerable debt already existed on the Institution, thought it prudent, in the first place, to make a trial of what might be obtained by way of public donation. With this view, they took it upon themselves to address a few Circular Letters, detailing what the Institution had already done, and was likely to do, and mentioning the distinguished patronage which similar Institutions, its imitators, had received in other towns. Without any departure from the principles of independence on which this Institution set out, the letter merely begged the public attention to its merits and claims.

Several of the Committee volunteered their services in what is generally a disagreeable task,—namely, to wait on the several Gentlemen to whom these letters were addressed; and they are happy to report, that they have hitherto met with the most flattering reception. During the few days which has already been devoted to this duty, and from the few individuals to whom application has as yet been made, they have realised upwards of One Hundred Pounds. The Committee have published the names of the Gentlemen who contributed, in the different newspapers, and in the Glasgow Mechanics' Magazine, and they have little doubt but they may yet be able to double the sum already collected.

It might perhaps be objected to the proceedings of the Committee, that in this matter they have acted without authority; but where their motives were so plain, and their success so great, they venture to hope that little blame will be attached to them. The thanks of the Members, at all events, are well due to the Gentlemen who have come forward in their behalf. No slight advantage which has arisen from the steps which the Committee have thus taken, is the public expression of satisfaction and approval of your conduct and proceedings hitherto. This should form a farther inducement to you to guard against any thing which in the slightest degree would tarnish the high character which this Institution now holds, not only in the eyes of our respectable fellow-citizens, but in the estimation of the whole country.

The Committee have also pleasure in reporting that they have made considerable progress in the procuring of Apparatus. At present there is making a most approved and elegant working model of a steam-engine, as well as mechanical models of levers, pulleys, &c. &c.

Two Members of the Committee are working at an air-pump, of an improved construction, as a donation for the Institution. Mr. Geo. Young is, in like manner, engaged in making a Hydrostratic press. Another Member is employed in constructing a Barker's mill. Mr. Jenkin's has finished an elegant drawing of a steam-engine, and is presently working at a wooden model of a section of the same. Messrs. Leishman and Co. are also making a model of a water-wheel for the Institution.

The Committee feel pleasure in mentioning the names of these individuals, from a strong conviction that it will induce many others immediately to come forward, in a way which will at once benefit the Institution, and distinguish their own talents and ingenuity. Having thus stated these gratifying circumstances, the Committee will now proceed to a more important subject,—the object of the present meeting."

After detailing certain matters, relating to the late Lecturer, the report proceeds to give the names of the six candidates, and concludes as follows:

"The Committee consider that the matter now to be decided upon, is one which is, perhaps, the most important which has hitherto occurred in the Institution. The welfare and character of the Institution is most intimately connected with the ability of its Lecturers. Although the election is annual, yet it is to be hoped, that this provision will operate only as a salutary check; and that a Lecturer shall be found of such talent and behaviour, as may be permitted to live and die in the service of the Institution. With this view, it is hoped, that it will not be the solicitation of friends, nor the force of prejudice or partiality, which will either give or withhold a single vote. If a Member cannot fully and conscientiously fix upon one of the Candidates as being best calculated to add honour to the Institution, and promote its interest, it would certainly be better that such a Member should decline voting, than bestow his suffrage from mere caprice.

The Members will bear in mind that the Lectureship embraces both Chemistry and Mechanics, and the certificates of the applicants will require to be examined under that consideration. An important distinction also exists between those with,

and those without apparatus, although this distinction is now of much less importance, since the Institution enjoys so flattering a prospect of soon possessing an apparatus of their own.

It would be a matter of great importance could the Members, at the present time, make an *unanimous* choice of their Lecturer; and with this view, the Committee, who, from their private inquiries and interviews with the Candidates, may perhaps be supposed to possess better opportunities of judging, were induced to think that they might have been excused in making to the Class a recommendation as to him whom they deem best fitted for the office. But in a matter so important, and judging between applicants so respectably recommended, they felt it a difficult task to be unanimous in such a recommendation.

The Members will easily see that there is a point of vast importance which no testimonials can properly decide. The Committee allude to the style, manner, and address of the Lecturers, especially with the view of managing a Class so unusually numerous, as that in this Institution. The best mode of ascertaining this important point, is unquestionably by requesting the Candidates to deliver a specimen Lecture in this Hall. The Committee are aware that several objections may be made to this mode of trial, and it was not till after much deliberation (and learning that at least three of the Candidates were willing to give such Lectures) that they this morning unanimously agreed to recommend the adoption of this plan.

The Committee would accordingly respectfully suggest, that this meeting be adjourned until this day fortnight, the 18th day of September current, and that all the Candidates be requested, in the interim, to deliver a Lecture, either on Chemistry or Mechanics, to the Members, in their Hall. If any of the Candidates decline to Lecture, (which it is not believed they will,) they may still be voted for, on the strength of their certificates.

The Committee propose that the Members be admitted to these Lectures, on showing their usual Tickets. But, for the honour of the Institution, and to defray the necessary expense incurred by the Candidates, each unsuccessful Candidate, who has so Lectured, shall be paid £3 3s. from the Institution funds. The Committee do not doubt that their Constituents must discover the propriety of the measure they now recommend, and they have only again to press on their attention, that in this, and the future stages of the election, the utmost propriety and caution be followed."

A variety of suggestions, motions, and countermotions were then made by individual Members, and explanations furnished by the Chairman, &c.

The result of the whole was a resolution, that the Lecturers, in the course of the week next but one, should, in an order to be decided by Ballot, each deliver a Lecture, on a subject of their own choosing, before the Members on successive nights; and that then on the evening of the succeeding Saturday, the 18th instant, the Class should proceed to decide upon their claims by open Ballot, and without farther public discussion.

4th September, 1824.

NOTICES TO CORRESPONDENTS.

J. W., Dunfermline, will be inserted.—Rusticus has been received.—Messrs. M'Lean and Nelson will be soon satisfied of the possibility of G. B.'s queries.—G. M. will be so good as to transmit the operation of his answer to the query of Rusticus.—J. P.'s account of Dr. Hale's instrument for taking deep soundings, will be inserted on the first opportunity.

Errata in our last.—Page 108, col. 2, line 10, for "*so that with,*" read "*with that of;*" and page 111, col. 2, line 10, dele *c*.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written. Original Patents, Inventions, &c. will be inserted on the shortest notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of Steuart & Panton, Cheapside, London; and Edward West & Co. Edinburgh.

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THE GLASGOW MECHANICS' MAGAZINE.

"Philosophy is the mother of all good Arts."—*Cicero.*

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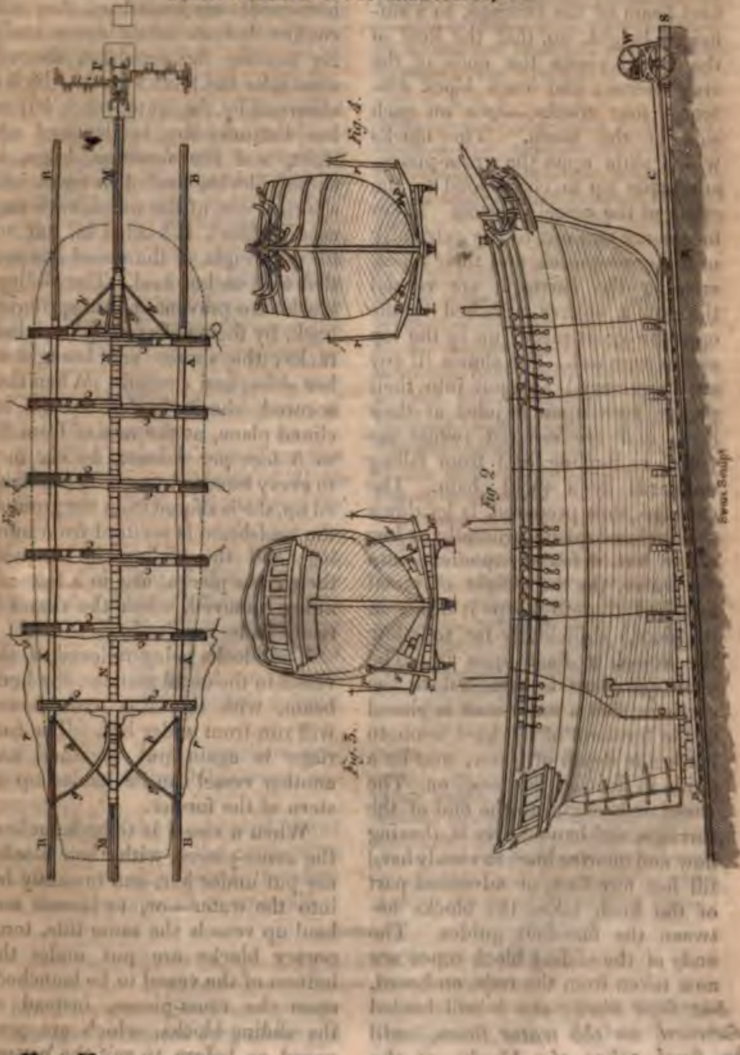
MORTON'S PATENT SLIP, FOR HAULING VESSELS OUT OF THE WATER FOR REPAIRS, &c.



MORTON'S PATENT SLIP, FOR HAULING VESSELS OUT OF THE WATER FOR REPAIRS, &c.

A CARRIAGE is constructed, as represented in the plan, with truck-wheels, to run upon the iron railways of the inclined plane, these truck-wheels having flanges to guide them. Blocks are laid upon the keel-beam of the carriage, to a sufficient height, so that the keel of the vessel clears the ends of the cross-pieces; and each block embraces four trucks,—two on each side of the beam. The blocks which slide upon the cross-pieces, are made up to correspond to the rising of the vessel's bottom. These blocks are run out to the extremity of the cross-pieces, and their ropes, crossing the carriage, are reeved through a sheave attached to the opposite cross-piece, up to the top of the rope rod. The shores (if any are necessary,) are put into their places, turn upon a joint at their heel, and are secured (while the vessel is floating on,) from falling outwards by a small chain. The carriage, thus prepared, is let down the inclined plane generally at low water, but, if found expedient, into the water, (as the weight of metal attached thereto keeps it down in its place,) sufficiently far to allow the vessel to float upon it. The chain-purchase is attached to the carriage; and a water-staff is placed at the fore-end of the keel-beam, to mark the depth of water, and be a guide in floating the vessel on. The vessel is brought to the end of the carriage, and hauled over it, (having bow and quarter lines to steady her,) till her fore-foot, or advanced part of the keel, takes the blocks between the fore-foot guides. The ends of the sliding block-ropes are now taken from the rods, on board, but kept slack; she is still hauled forward, as the water flows, until the keel takes the blocks at the contracted part of the guides, which are just wide enough to receive it. Being still afloat abaft, (having been previously so trimmed,) the vessel is then adjusted over the blocks abaft by a water-line. When the iron-guides are hauled up, they will confine her to settle down truly. By heaving the purchase, she will soon take the blocks abaft, which is observed by the water-mark left on her bottom; she is trimmed upright, and the foremost bilge, or sliding-blocks, hauled in tight. As she rises out of the water, each succeeding block is hauled in, but not till the weight of the vessel has settled well on her keel. The sliding-blocks are prevented from springing back, by their palls falling into their racks; the shores are brought to her sides, and cleared. When thus secured, she is hauled up the inclined plane, at the rate of from $2\frac{1}{2}$ to 5 feet per minute, by six men to every hundred tons. Being hauled up, she is shored from the ground; the keel-beam is secured from moving; and the sliding-blocks, with their cross-pieces, are in a few minutes removed, when the vessel is ready to be repaired.

The blocks being relieved of the vessel in the usual manner, the keel-beam, with the after cross-beam, will run from under her. The carriage is again put together, and another vessel can be hauled up astern of the former.

When a vessel is to be launched, the cross-pieces, with their blocks, are put under her, and instantly let into the water—or, to launch and haul up vessels the same tide, temporary blocks are put under the bottom of the vessel to be launched, upon the cross-pieces, instead of the sliding-blocks, which are prepared as before to suit the bottom

of the vessel to be taken up; the vessel is launched; when she, and the temporary blocks which steadied her, float from the carriage, and the other vessel is taken on, and hauled up as formerly.

Advantages of this Invention.

1st, The vessel being above ground, the air has a free circulation to her bottom, thereby requiring no firing; the men work with much more comfort, of course quicker; and, in winter particularly, they have light better, and much longer, than within the walls of a dry dock; considerable time is also saved in carrying and removing the materials for repairing the vessel.

2d, Such is the facility of its operation, that ships can be hauled up, inspected, and even get a trifling repair, and be launched the same tide: and the process of repairing one vessel is never interrupted by hauling on another, as is the case in dry docks, from the necessity of letting in the water.

3d, The vessel is hauled up the inclined plane, at the rate of $2\frac{1}{2}$ to 5 feet per minute, by six men to every hundred tons; so that the expense of hauling up, and launching a vessel, from 200 to 300 tons, does not exceed thirty shillings.

4th, A slip can be constructed at about one-tenth the expense of a dry dock, and be laid down in situations where it is impossible to have a dock built.

5th, There is no previous preparation, or fitting bilge-ways, necessary.

The chain of the mechanical power is attached solely to the carriage on which the vessel is floated; therefore the vessel is exposed to no strain.

The whole apparatus can be removed from one place to another, and be carried on ship-board.

Description of the Plate.

A, A, A, A, side-beam of the carriage, with trucks or rollers beneath, at each cross-piece.—B, B, B, B, side-way.—*c*, *c*, *c*, *c*, *c*, *c*, *c*, cross-pieces.—*c*′, *c*′, cross-pieces, with racks.—*c*″, *c*″, aftermost cross-pieces.—*b*, *b*, braces.—*g*, *g*, iron guides.—*b*′, *b*′, oblique braces.—*g*′, *g*′, guides to receive the fore-foot of the vessel.—*s*, *s*, *s*, *s*, *s*, *s*, *s*, *s*, *s*, *s*, sliding-blocks.—*r*, sliding-block rope.—*s*′, *s*′, shore.—*r*′, *r*′, rope for hauling guide or crutch.—M, midway, with rack.—N, N, main or keel beam of the carriage.—P, purchase.—W, wheel and pinion, capstan, or other purchase.—S, large stone.—C, chain.—K, keel of the vessel.—G, guide for the after-part of the keel.—*p*, rack-pall.—R, R, inclined plane, road, or platform, laid nearly with the same slope as the slips commonly used for building ships.—Fig. 1, plan of the slip and carriage.—Fig. 2, side-view of the ship.—Fig. 3, stern-view.—Fig. 4, head-view.

At Stobcross, a little below the New Quay, on the Clyde, at Glasgow, there is a slip on the same principle as Mr. Morton's, but differing a little in the application. The vessel is there made to rest on the bilge, or under part of the vessel, instead of the keel as in the above plan; by this means, she requires less water to raise her on the carriage, as the groove between the iron rail-ways admits the keel, and allows it to move up and down freely, without requiring any support. The carriage consists of two separate beams, resting on the rail-ways, without any intermediate keel beam or cross-pieces to connect them; to the ends of both are attached *two* connected series of iron rods, and *two* chains, by which they are drawn up the inclined plane.

ON STEAM NAVIGATION IN CANALS.

(Read before the Glasgow Philosophical Society.)

Mr. President,—About twenty years ago, *prompted by curiosity*, I went to see a steam boat plying on the Great Canal. It had been fit-

ted up by a Mr. Symington, and was said to be patronized by the late Lord Dundas. The arrangement of the machinery in that steam boat was considerably different, although the principles of its construction were the same as those of the modern ones plying at present on the Clyde. To the numerous spectators its utility as a moving power was obvious, as at that time it was dragging four heavy loaded vessels; but the surge that was caused by its wheel (for it had but one) was considerable; and, when forced behind it, met the bow of the next vessel, which impelled the waves on the banks, evidently to their great injury, by washing the earth into the canal.

Since that period, several engineers have turned their attention to obviate this defect, and have puzzled themselves more in the construction of a steam boat to remedy this evil, than in the attempt to improve the canal so as to admit of the navigation of the common steam boat. I recollect of seeing it mentioned in some periodical publication, since steam boats had become so common, and their utility for inland navigation so obvious, that, at a canal in the neighbourhood of Bath, they had either been proposed or tried by rack and pinion working on the pathway, without the use of paddles. The necessary turnings and windings, which are in almost every canal, and other impediments, such as feeders, wasters, and bridges, are strong objections to any plan of this kind. Extravagant ideas, such as building a canal of ashler stone-work, or lining its sides with cast-iron, may have often occurred, but no sooner were they thought of, than they were abandoned. An idea of an improvement that would be effectual, has often passed through my mind; and *I humbly suggest the following* observations, as perhaps worthy the consideration of practical men engaged in such useful undertakings.

The idea may be reckoned simple, and the suggesting of the same may seem to possess little merit, because it has no glaring effect to recommend it; yet it has already received the sanction of experience and though neglected by the passing multitude, it has not escaped the eye of the curious. On the bank of the Clyde, opposite to the new quay at the Broomielaw, about two years ago, some stones were laid down as a facing or defence to the bank against the tide. These stones are farther extended and consolidated, and they are washed perhaps several hundred times a-day by the waves or surge of steam vessels, yet none of the earth is washed into the river. Indeed, the case is so much the reverse, that the stones act as a filter, and the waves falling back through them, appear much purer as they subside.

I lately had an opportunity of judging of the practicability of adopting this plan on the canal, by taking a survey of it, on both sides, from Port-Dundas to Lock 16. The quantity of whin-stone rock on its banks is great; and there is, in particular, on the Barr-hill, before reaching Kilsyth, a quantity sufficient to cover the banks of all the canals in Europe in the manner I propose. Now, if the depth of a spade, or nine inches, of the earth were taken off the present facing of the canal to the perpendicular depth of two feet three inches, it would give the stones the proper base and inclination when thrown out of the boats. This should be brought to the present height, and inclined over about two feet three inches more, thus making it in all one yard and a half —the supposed depth of the agitation and rise of the wave. This is all that would be necessary to be

done on the south bank for the whole way. The north bank ought to be done in the same manner; but, this being the tracking-path, a foot-road might be preserved, at no great expense, by laying small stones, one yard in breadth, as recommended by M'Adam in his publication on road-making. Any waves that might dash over these stones would return to the canal much purer than they were thrown out, as the water would return through the layer of stones much slower than it was impelled over them, and it would filter in its descent.

I might enlarge on the certainty of success in adopting this plan, and might advance many reasons in its favour; but this will be obvious to those who have seen its effects on the banks of Clyde. The great object to be gained is to prevent the destroying of the banks, and the washing of the earth into the canal. The facing of the banks with stones will strengthen and consolidate them, and, instead of tending to wash the earth and mud into the canal, will retain what is moved from the centre, and gradually increase the depth. This plan, besides, will be eventually much cheaper than the present, as the banks have to undergo constant repair.

An engine of ten horse power would enable track boats of the size of the present ones to make their trip in a much shorter time. Their funnels might be made also with folding joints, like what are named jocteleg masts, or in pieces to move up and down like the lengths of a telescope, so that the draw-bridges will not require to be raised, so as to retard their progress. The coals for fuel would also be less expensive there than in many places, as they are to be found in abundance on the banks of the canal.—T.

SKETCH OF THE HISTORY OF PHILOSOPHY,

Particularly with reference to Mathematical and Mechanical Science.

The Mathematical Sciences have been long valued for their various and extensive utility. In almost every branch of Natural or Mechanical Philosophy, their paramount importance is universally acknowledged. In the branch of Mechanics, however, they are well known to be absolutely necessary, not only because its first principles are *mathematically* demonstrated, but because it is indebted to these sciences for the rapid advances which it has made during the last half century, and which have brought it to a state bordering upon perfection. Of all the sciences, Astronomy is that which is most indebted to the Mathematics. By their aid, it has reached that sublime and towering elevation on which it stands at the present moment; and has at length attained such a state of excellence, as to receive the universal assent of philosophers that it is absolutely perfect,—a thing which cannot, and perhaps never will be, said of any other human attainment. By this science, man has been enabled to explore the regions of the stars, and even to ascertain the composition of the universe. So true was the saying of the ancient Philosopher, that "Arithmetic and Geometry were the two wings whereby man might mount up to Heaven." From such an eminence, however, we must at present descend, and take a view of the infant state of those sciences which have produced such a mighty change in the opinions of mankind, and which have enabled them to soar so far above the grovelling occupations of

a savage life. Such a procedure must evidently be accompanied with eminent advantages to him who may be desirous of entering upon the study of a species of knowledge which has for ages occupied the most learned and the wisest of their race. Unacquainted as he may be with the first feeble advances which the founders of science were able to make, the narration of them must have an inspiring influence over his mind, as it will show him, that, so far from despairing of the acquisition of knowledge, he may thence draw the brightest hopes of his own rapid advancement. He will see that he has only to follow the footsteps of the great and leading spirits of science, assured that these, once gained, become infinitely easier to all that follow; just as, when a band of adventurous warriors, invading an unknown country, have, in the progress of their march, been intercepted by a river whose depth is unknown, and all are apparently at a loss how to act, till one, bolder than the rest, plunges into the stream at once, and, having found footing, and at length gained the opposite shore, invites his companions to follow without fear of danger. This simile, however, if just in one sense, affords also an apposite contrast in another. By the changes that may take place in the channel, or the banks of the river, after the overflowing and rapidity of its waters during the time of an inundation, or flood, it may be rendered so totally impassable that the warriors, on their return with the spoil, may, in attempting to recross its streams without examination, be finally overwhelmed in ruin. Not so is the case with the votary of science; the footsteps which he successively gains, in his progress, remain immoveably firm, till he reaches the end of his course, and he may trace them and retrace them at pleasure; for, having stood the attacks of ages, they are at last found to be established on principles eternally true, and capable of carrying conviction to the mind, even though the whole material world were to vanish as a scroll, and "leave not a wreck behind."

In tracing the progress of science, it is frequently not so difficult either to ascertain what was early known in any of its various departments, or to describe it properly when once it is ascertained, as it is to mark the chronological steps in the series, and to show the gradations by which it may have passed from its rude, accidental, or imperfect origin, to the mature state in which we now behold it, and from which we are incessantly deriving so many advantages. Moralists have frequently illustrated the nature of human life by the simile of a bridge of numerous arches, of which the whole is seen, except the extremities, which are pictured as enveloped in clouds, thereby showing that the beginning and the termination of our existence are equally unknown; if it may be allowed to invert this simile, it may then be applied to the history of science, where the extremities are illuminated, but mists and darkness hang over the greater part of the intervening space.

To the mechanic aspiring after philosophical knowledge, it will be useful to fix his attention, for a little, on the extremities that are most distinctly marked—to contrast the appearance of the early germ with that of the mature plant, and to bring before his intellectual eye the astonishing difference between the *first thought* and the expanded series of deductions from it—between the naked and simple propositions that were first discovered, and the complete system of truths, in particular sciences, of which they at

present form the most inconsiderable part.

In recounting the history of the Mathematical Sciences, it is customary for the historian to notice all the philosophical discoveries of the men who have been distinguished for their predilection for these sciences; not only because they are in general intimately connected, but because in many instances the most brilliant of the former were owing to their researches into the latter; and, dry and unentertaining as the Mathematics have been by many considered to be, yet they have produced, in the minds of the *discoverer*, more extatic feeling than ever was excited by any other human pursuit. Removed from the things of sense and of time, the mathematician feasts on a banquet of pure intellectual joy of his own creation, and he feels as if his whole frame were encircled by a kind of airy sublimation, which renders him for the moment insensible to all the gross and sensual pleasures of the material world. Unproductive as the study of these sciences seem at first sight to be, they have contributed more to the laying a solid foundation for the noble pyramid of knowledge, whose summit now reaches to Heaven, than all the achievements of the political, the moral, or the speculative philosopher, from the days of Aristotle to those of a Bacon, or a Locke, of a Hume, or a Stewart.

Science began to dawn in those genial climes which are first illuminated by the rising sun. And, like that luminary, though its early rays were comparatively feeble and dimly seen through the mist of an extended atmosphere, yet its progress, though less rapid, was gradually enlightened by the fire of superior genius, till it ultimately rose to its meridian height, and burst forth with unlimited splendour. Let us hope that the noon-tide of knowledge, which has thus risen upon the human race in our happy days, and has spread itself through all classes of society, will continue to penetrate into the darkest regions of ignorance, till there be no human mind which has not felt its cheering rays, and till in Science, as in Religion, "no man shall teach his brother, but all shall possess knowledge, from the least even unto the greatest."

Historians, fond of showing the extent of their imagination, have attempted to involve the origin of science (like that of the human race) in fable. Josephus ascribes its origin to a period before the flood, and to the sons of Seth the honour of being the first Astronomers; he states that they were observers of the heavenly bodies, and that, in order to perpetuate their discoveries, and to secure them from the injuries either of a deluge or a conflagration, they had them engraven on two pillars, the one of stone, and the other of brick; the former of which, he avers, was yet standing in Syria in his time. This knowledge, as the poet says,

> "Was first by God, to first born Adam given;
> From him to Seth it came the best of men;
> And justly, since the richest gift of Heaven,
> On flood surviving pillars he enrolled."

What credit is due to such fancies, we shall not here stop to inquire; suffice it to observe that the Jewish historian must have supposed his readers very credulous to believe in them. It was not indeed till many ages after the flood that science assumed any thing like form or consistency. When mankind began to relinquish their wandering and savage life, when the Nimrods of the first era of society had ceased to hunt their fellows like the wild beasts of prey, and when general laws or conventions were established for the common good; when, by common consent, it was agreed that

every individual should provide for his own subsistence, without seizing what belonged to another; it was then that necessity, self-preservation, and domestic comfort, the great springs of physical exertion, gave rise to the most useful arts. Huts were built; iron was forged; the lands were divided; and the courses of the stars were observed. The necessity of the last would be felt, by observing that though the earth yielded spontaneously the most common of her productions, and such as preserved man in his savage state from starving, yet it would soon be discovered that there were other fruits of far greater utility, which required labour and cultivation to bring to a state of perfection, and that it was necessary to regulate their labour by the seasons of the year: thus, the ground was sown, the harvest was reaped, the fruits of the year were preserved, and man enjoyed the result of his labours, till bounteous nature furnished him with a farther supply.

These observations and operations, at first rude and unskilful, were connected with science by a secret tie, though for a long time, experience and custom was the only guide. The arduous labour of hunting and fishing, and the employments of the field, prevented man from ascending immediately to general and abstract ideas, and confined the limits of his thoughts and actions to his natural wants. At length arose some aspiring genius, who, collecting the traditionary knowledge, observations, and sayings of his predecessors, formed them into a system, rude, perhaps, and incongruous at first, but sufficient to show that man was a being destined to hold a higher rank among created beings, than had hitherto been felt or imagined.

"It was then," says an elegant historian, "that man beheld with new eyes, the magnificent spectacle which nature exhibited on all sides to his senses and imagination; he learned to examine things and to compare them with each other; ideas acquired from physical objects were transported as it were into an intellectual world; the phenomena of nature were studied with discriminating attention, and the mind was impressed with a desire to know the causes by which they were produced. Geometry, confined at first to the art of measuring the fields, was extended to other purposes, and gave rise to loftier and more difficult problems. Astronomy was enriched by regular observations, and by instruments adapted to increase their number, and to give them the requisite degree of accuracy and connection.—Machines were invented, in which a skilful combination of the several powers of wheels and levers was employed for transporting the heaviest loads: in a word, all the parts of mathematics successively advanced; and their progress would in all probability have been more rapid and considerable, had not fanaticism and ambition frequently obscured the flame of genius for a long series of ages; but, as a fire concealed beneath the embers, it resumed its lustre in happier times, and at length burst forth with that flood of light which now illuminates so great a portion of the earth."

It is related by Herodotus and Strabo, two Grecian historians, that we owe the invention of Geometry to the Egyptians, who found it necessary to be able to assign to every one his own particular property, after the yearly inundations of the Nile, which frequently carried away the landmarks and boundaries by which it was distinguished; and so that every man might at least obtain a portion of land equal to his own,

in the event of the total destruction of such landmarks. From the necessity which thus compelled them to measure their land, they might be led to investigate and discover the properties of figures, and the priests of that country, who excelled those of every other in learning, might prosecute these studies as an amusement, or as instruments to aid them in the absurd and futile pursuits of astrology.

The warming and enlightening rays of science, however, which had thus begun to dawn upon the benighted world, were soon obscured by the cheerless fog of despotism, and it was found necessary to transplant them to a more auspicious clime. The system of knowledge, imperfect as it was, which had been created by the efforts of early and unfettered genius, became the exclusive property of a priesthood, who debased it by rendering it subservient as an engine of power, either for the purposes of the state, or of a gloomy and degrading superstition. Buried in the temples of Egypt, and enwrapt in the hieroglyphics of her magi, the discoveries of happier days were, by silence and darkness, for a time concealed from the world. Thus has it ever been, when an individual of the race, surrounded with pomp and show, flattered by a servile herd, and puffed up with the hereditary pride or imaginary ideas of his own greatness, attempted to rule his fellow-creatures with a rod of iron; and, not content with absolute power over their persons, endeavoured to enslave their minds. Science and the arts have ever, in such circumstances, suffered a decline, if not a total obscuration.

The day-spring of science at length arose in a more favoured land; and Greece, though but a speck upon the surface of the earth, commenced that career of glory, which terminated in her never-dying fame. In the words of an elegant writer, "she gave early token of those lasting benefits she was destined to confer on the human race. Her sages gleaned instruction by visiting foreign lands, and the seats of ancient renown. They gathered the dying embers of science, and revived them by the breath of their genius. But, quickly emerging from a state of pupilage, they displayed the riches of a lively fancy, and all the resources of a fertile invention."

(To be continued.)

ON CERTAIN ELECTRICAL PHENOMENA OBSERVED AT SEA,

With an Account of St. Elmo's Light.

Of all the dangers to which the seaman's life is incident, there is none so fearfully sublime, when viewed at a certain distance, or so dreadfully appalling, when under the impulse of immediate contact, as that combination of meteorological and electrical phenomena, known under the common name of "thunder and lightning." In the dark midnight of an autumnal cruise, as repeated through a series of years upon the southern shores of France, by the unremitting perseverance of the British fleet, these various sensations have been experienced by thousands. In the midst of a numerous fleet of "Britain's best bulwarks," exposed on such a night to sudden squalls and baffling shifts of wind, when the uncertain drops of rain fall few, but heavy on the deck—when the ship, at times unmanageable, rolls in the trough of the agitated sea—when the distant thunder is heard pealing from off the land, and the vivid lightning discloses at every flash, the scattered fleet—in circumstances such as these is beautifully exemplified the orderly and determined resolution of the British seaman, whose precarious safety not only deserves, but claims, in the strongest terms, the ingenuity of experimental philosophy in his behalf.

Having thus briefly hinted at the ex-

tent of danger to which a man-of-war is liable, from the dreadful effects of the electric fluid, the mind is naturally roused to the contemplation of such plans or devices, as may tend in any way to counteract or prevent the repetition of such calamitous occurrences. The only one, as far as is consistent with my personal experience, that has ever been adopted in the navy, is that of leading a metallic chain of thin short bars, as a conductor, pointed upwards at the track, and down by the back-stays to the water's edge; and every large ship is either fitted with one of these, or may be supplied upon application.

This apparatus is, of course, attached to the maintop-gallant-mast-head, as being the most lofty; but it does not always follow, that the lightning is to strike in that direction, having once had the dreadful opportunity of witnessing, with my eyes fixed upon them at the moment, not less than fifteen most valuable men, all upon the bowsprit and jib-boom, killed or dreadfully scorched, as it were, in the "twinkling of an eye." Some were precipitated into the water, and others, lying dead across the boom, continued in the posture they had assumed before the accident took place. This happened on board a 74 at Port Mahon, at a time when all her yards were manned, in the operation of furling sails.

It does not accord with my recollection, whether her conductor was in use or not; but if any real dependence is to be placed on such a contrivance, it appears probable that *one* only is insufficient.

There are, however, opposite opinions as to the merit of this apparatus, as well also as to the propriety of its being used at all; and I do not remember, in spite of repeated accidents, that either the Board of Admiralty, or those great seamen and commanders of the Mediterranean fleet, Lords Nelson, Collingwood, and Exmouth, ever did enforce any general regulation on the subject.

A conductor at the maintop-gallant-mast-head, can only be looked upon as an agent more powerful than the mast itself, but by no means calculated positively to draw within its own influence, every portion of electric matter, which may have come first in contact, or in near appulse with any other point; and although the mast-head is almost invariably the first to suffer, yet it is within my own knowledge, though I was not actually present, that several men, in the act of withdrawing their washed clothes from the *main rigging*, were killed and scorched by the descent of the electric fluid.

It would be not only curious, but useful to ascertain, if possible, the following circumstances. 1. How many ships have been struck with lightning, out of a given number in a given time? 2. What has been the loss of lives, the extent of damage, and the *expense of repairs?* 3. How many of these ships were habitually in the practice of using conductors? and, 4. Did any of the ships, having them then in use, suffer from the effects of lightning, and in what manner? It is possible that some of your intelligent readers, whose central situation or official duties, afford the best opportunities of acquiring information, may have it in their power to render some illustration, replete with the deepest interest, and the most beneficial results.

Among those who disapprove, or who are at least doubtful as to the expediency of adopting the ordinary metallic chain, I have no hesitation of being enrolled. The contact of electric fluid, under any circumstances, ought carefully to be avoided; and no single conductor on board of a ship, with her top-gallant-yards across, can positively regulate or restrain the devious course it usually assumes. A ship in that situation, presents at least twenty-four distinct points between the jib and driver boom ends, all more or less capable of exerting the power of attraction, and liable thereby to occasion a loss of lives; neither does it follow, that the lightning is positively to fall on any one of those points in preference to another, in spite of the precaution of placing conductors at particular points for that particular purpose.

In the month of July, 1811, being then on board H. M. S. Kent, of 74 guns, off Toulon, the main and mizen masts were shattered by lightning, from the truck downwards. Furling the maintop-gallant sails, the fluid deviating partially, killed one man, and scorched three or four others then upon the yard. Had there been a conductor up at that time, the chance is, that these brave men might have been saved; but it does not actually follow that the mizen-mast would have been equally secure.

Granting, then, the utility of a *chance*, we have a right to conclude, that the

lives of those aloft, or out upon the boom, and even the masts and boom themselves, are still but insecure, without a conductor being attached at each, which would comprise in all an additional quantity of gear, not reconcileable to the trim and gallant order of a British man-of-war.

The electric matter in the atmosphere, must either be in a quiescent or an active state. When the clouds become surcharged and attract one another, the conductor might possibly be of use. But, again, if we consider, as frequently occurs, the atmosphere and the clouds charged heavily with matter, though still quiescent, could not the presence of such a conductor at such a time, operate in exciting a burst of electricity, pregnant with every danger, which would not have happened, without the presence of such conductor itself, such conductor being a far more powerful agent than the mast, and not altogether capable of controlling the danger arising from the action of itself? The pointed mast is certainly always liable to influence, or attract the quiescent matter with all its force, but much more so is the conductor. Where, then, can be the great propriety of using an apparatus of doubtful tendency, which, though in some instances capable of fortuitous benefit, is, at others, liable to occasion incalculable distress? There are instances, no doubt, of the fluid being carried by the conductor most successfully to the water's edge; but there is also another chance to the contrary, as well as a great probability, that many descents of the electric fluid, either with or without damage, would never actually have occurred, had it not been for the presence of this more powerful apparatus. Whenever it can be fully proved, that accidents never have, nor never can take place, under the use of one or more conductors, whether they have been the means of exciting the electricity from the quiescent state or not, then, and not till then, can their undoubted utility be satisfactorily demonstrated.

In the instance before mentioned, when the fluid fell with such violence on the jib-boom, some thunder and lightning had previously been seen at a distance. At the ship all was calm, but dark and threatening. Without the accompaniment of thunder, the fire darted, as it were, not from a cloud, but from the immediate atmosphere itself, charged heavily with matter, and called into activity by the presence and contiguity of the ship. Had there been a conductor aloft, it is possible that the descent would have been redoubled; or, had there been no ship at all, nor the presence of any such attractive power, it is probable that the lightning would never have occurred.

Independent of the common electric fluid, the atmosphere appears sometimes to be impregnated with another description of luminous electric meteor, which has been known to be attracted, and settle quickly at the ship's mast-head, without producing any of those dire occurrences before alluded to. This particular appearance has been denominated by foreign seamen, *Saint Elmo's Light*, a beautiful instance of which I had once an opportunity of witnessing.

In the month of June, 1808, passing from the island of Ivica to that of Majorca, on board a Spanish polacca ship, fitted as a cartel, and manned by about thirty ruffians, Genoese, Valencians, and Catalonians; a fine southerly gale, by seven in the evening, brought us within six or seven leagues of the anchorage in Palma Bay. About this time, the sea-breeze failing us astern, was shortly succeeded by light and baffling breezes off the land. No sooner had the setting sun withdrawn his golden beams from the tops of the lofty hills, which rise to the westward of the town, than a thick and impenetrable cloud, gathering upon the summit of Mount Galatzo, spread gradual darkness on the hills below, and extended at length a premature obscurity along the very surface of the shore. About nine, the ship becalmed, the darkness was intense, and rendered still more sensible by the yellow fire that gleamed upon the horizon to the south, and aggravated by the deep-toned thunder which rolled at intervals on the mountain, accompanied by the quick rapidity of that forked lightning, whose eccentric course, and dire effects, set all description at defiance. By half-past nine, the hands were sent aloft to furl top-gallant-sails, and reef the top-sails, in preparation for the threatening storm. When retiring to rest, a sudden cry of St. Elmo and St. Ann, was heard from those aloft, and fore and aft the deck. An interpreter called lustily down the hatchway, that St. Elmo was on board, and desired me to come up. A few steps were sufficient, and, to my great surprise, I found the topsail-yards deserted, the sails loose, and beating in the inconstant breeze, the awe-struck and religious mariners, bare-head-

ed, on their knees, with hands uplifted, in voice and attitude of prayer, in earnest and muttering devotion to St. Elmo or St. Ann, according to the provincial nature of their speech.

On observing the appearance of the masts, the main-top-gallant-mast-head, from the truck, for three feet down, was perfectly enveloped in a cold blaze of pale phosphorus-looking light, completely embracing the circumference of the mast, and attended with a flitting or creeping motion, as exemplified experimentally by the application of common phosphorus upon a board; and the fore and mizen top-gallant-mast-heads exhibited a similar appearance in a relative degree.

This curious illumination continued, with undiminished intensity, for the space of eight or ten minutes, when, becoming gradually fainter and less extensive, it finally disappeared, after a duration of not less than half-an-hour.

The seamen, in the mean time, having finished their devotions, and observing the lights to remain stationary, returned promptly to the yards, and, under favour of this "Spirit of the Storm," now quickly performed that duty, which, on a critical conjuncture, had been abandoned, under the influeuce of their superstition and their fears. During the prevalence of the lights, as well as through the remaining hours of night, the wind continued, except in occasional puffs, light and variable; and the morning ushered in with a clear sky, a hot sun, and a light southerly breeze, which, in due time, brought us safe to the anchorage of Palma.

Conversing with the interpreter on the nature of this extraordinary atmospherical phenomenon, he expressed his implicit belief that it was provided by the immediate power of St. Elmo, the tutelar deity of "those who travel on the vasty deep," in regard to their interests in a moment of sudden danger; and used every argument to persuade me, that the present safety of the ship was due to the very timeous and friendly interference of this aerial demigod; and that no accident could possibly have happened to the sails, while the seamen were at prayers, as long as the light glowed stationary on the mast. Had the light, he continued, descended gradually from the mast-head to the deck, and from thence to the kelson, as he had often seen it, the event would have prognosticated a gale of wind or other disaster, and, according to the depth of the descent, so would be the nature of the evil to come. In the present instance, the lights gradually disappeared, like the snuff of a candle, and the weather continued clear and fine for several subsequent days.

This phenomenon, by many, is held to be fabulous, and is so alluded to by the greatest living poet of the day:

> "Of witch, of mermaid, and of sprite,
> Of Erick's cap, and Elmo's light;"

but Falconer, both seaman and poet, writing from experience, says,

> "High on the masts, with pale and livid rays,
> Amid the gloom portentous meteors blaze."

Humboldt, Ed. Jour.

ON THE ATMOSPHERE.

(Concluded from page 122, Vol. II.)

The complicated and beautiful contrivances, by which the waters are collected "above the firmament," and are at the same time "divided from the waters which are below the firmament," are inferior to none of those adaptations of Infinite Wisdom, which are perpetually striking the inquiring mind, in the animal and vegetable kingdoms. Had it not been for this nice adjustment of conflicting elements, the clouds and concrete vapours of the sky would have reached from the surface of the earth to the remotest heavens; and the vivifying rays of the sun would never have been able to penetrate through the dense mists of perpetual precipitation.

Nor can I here refrain from pointing out a confirmation, which incidentally arises, of the Mosiac account of the creation of that atmosphere whose wonders we have been endeavouring to unravel. The question has been asked, How is it that light is said to have been created on the first day, and day and night to have succeeded each other, when the sun has been described as not having been produced till the fourth day? The Sceptic presumptuously replies, this is a palpable contradiction, and the history which propounds it must be false. But Moses records that God created on the first day, the earth covered with water, and did not till its second revolution upon its

axis, call the firmament into existence. Now one result of the previous inquiry has been, that a sphere unequally heated and covered with water, must be enveloped in an atmosphere of steam, which would necessarily be turbid in its whole depth with precipitating moisture. The exposure of such a sphere to the orb of day would produce illumination upon it; that dispersed and equal light, which now penetrates in a cloudy day, and which indeed is "good:" but the glorious source of light could not have been visible from its surface. On the second day, the permanently-elastic firmament was produced, and we have seen that the natural consequences of this mixture of gaseous matter, with vapour, must have been, that the waters would begin to collect above the firmament, and divide themselves from the waters which were below the firmament. The clouds would thus be confined to definite plains of precipitation, and exposed to the influence of the winds, and still invisible sun. The gathering together of the waters on the third day, and the appearance of dry land, would present a greater heating surface, and a less surface of evaporation, and the atmosphere during this revolution would let fall its excess of condensed moisture; and upon the fourth day it would appear probable, even to our short-sighted philosophy, that the sun would be enabled to dissipate the still-remaining mists, and burst forth with splendour upon the vegetating surface.* So far, therefore, is it from being impossible that light should have appeared upon the earth before the appearance of the sun, that the present imperfect state of our knowledge, will enable us to affirm, that, if the recorded order of creation be correct, the events must have exhibited themselves in the succession which is described. The argument, therefore, recoils with double force in favour of the inspiration of an account of natural phenomena which, in all probability, no human mind, in the state of knowledge at the time it was delivered, could have suggested; but which is found to be consistent with facts that a more advanced state of science and experience have brought to light. If, however, it were reasonable to expect that the ways of God should in all cases be justified to the knowledge, or rather the ignorance, of man, the boldest philosopher might well pause before he applied the imperfect test of a progressive philosophy to the determination of the momentous questions involved in these considerations.

* I am indebted to Mr. Granville Penn's admirable "Estimate of the Mineral and Mosaical Geologies," for my first hint upon this subject. The greater part of this Essay had been written before I perused his work; and I was pleased to find that I had unconsciously proved the necessity of that turbid state of the aqueous atmosphere, previous to the creation of the firmament, upon the probability of which he has argued in such a masterly and convincing manner.—J. F. D.

VARIOUS COMMUNICATIONS.

MANUFACTURE OF KELP.

Sir,—Of all the conveniences which we owe to Art, and they are various, I do not know that there is any of more universal utility than the article *kelp*. Our glass—of light and liquor, the medium—it is to kelp we owe! Our soap, to beauty so essential, it is to kelp we owe! Our dye-stuffs, and bleaching-stuffs, of ten thousand names, it is to kelp we owe! What then, shall it be said, do we not owe to our ingenious and intrepid Highlanders, who, to find this strange commodity, the dominion of Neptune first explored?

But, Sir, of this monosyllable, kelp, few, at least of your Lowland-bred readers, we *are persuaded, can form* any thing like an *idea*; and indeed they are excusable, for if by sensation most or all of our ideas are acquired, of a thing hitherto to all *their* senses exotic, how can they have an idea?

Wherefore, Mr. Editor, this mystery I shall, for the information of my fellows, assay, in my own artless manner, to unravel.

In Summer, then, when *Sol*, "to warm earth's inmost womb," darts down his fervidest rays, the Gothic tribe, with their whole domestic train, betake them to the "spicy shore." There grows, on ground-rocks, a certain nondescript sort of thing, called sea-weed, attainable only at low ebb; which circumstance, by the bye, adds not a little to the novelty of

the thing; for the dispatchful troop no sooner fall to work, than the hoary sire, as if incensed at their encroaching upon *his* jurisdiction, begins, with almost as much acceleration as once he did stern Achilles, to chase them away.

This sea-weed being cut, is removed to some contiguous purlieu, and there with nicety exposed, for two or three days, to the Solar ray; being thus rendered combustible, a stone kiln, of about ten feet by two, is erected. In this kiln, some heather being deposited by way of a kindler; of the parched sea-weed a thin layer is set fire to, and now, to feed this fire, some experienced sage is appointed. This task is rather a critical one; for, if the kiln be not duly fed, which, by reason of the cloud-meeting smoke, is not easily ascertained, the proceeds will be *Gaundar* (a white porous substance); if over-fed, and surfeited, *Dudau* (black ashes), will infallibly be the product.

The voracious kiln being now served for perhaps a whole live-long day, the said sage at last withholds his bounty; and now *four Atlantean* forms grasp each his *Claudan* *; with these they assail the passive embers, nor cease, till, by dint of real labour, what was erewhile a dry, but glowing pile, is now become a *liquid* boiling substance, called kelp; which substance, once congealed, it requires *art* and *parts* to break.

I am, Sir, your's, &c.

L. M'L.

Coll, September, 1824.

* A massy pluked iron, with a wooden shaft.

ON WINDOWS.

Mr. Editor,—When I stated my objections to the improvements on windows, by Mr. Johnstone, I had no idea that it would have gone South of the Tweed; but as it has done so, and as Mr. Saul, of Lancaster, seems a more important antagonist than either Mr J. or R. A. Stonehouse, I must endeavour to answer him accordingly. He seems to wonder if a Glasgow journeyman wright will have the temerity to find fault with the rigging of his invention, which he considers the *ne plus ultra* of windows. I must, therefore, tell him, as the Provost, or one of the Magistrates of Glasgow, said to the mob gathered to destroy our venerable Cathedral at the Reformation, that "He, too, was for pulling down the old Church, but not till they had got a new one, or a better one;" so I, too, am for a reformation on windows, but not till I have seen a better plan than what has hitherto been proposed.

In his letter, dated 12th June, 1824, he states that 'A Journeyman Wright' would have done better, had he taken the beam out of his own eye, before he attempted to take the mote out of Mr. J.'s eye. I have to say, that if there is a beam in my eye, I do not consider that his *spectacle* of a window will enable me to see a whit clearer to assist my neighbour Mr. J. which I would gladly do, as I consider his principle much nearer the point in question than his *Jingling Johnny*, of which, and its inventor, I have never seen or heard, till this Saturday, 11th September, 1824, half-past ten evening; nor did I ever see any person that heard of, or saw it; so that it would appear that Mr. Saul's invention has not made that noise in the world which he supposed.

The new plan, elevation, and section, which emblazons the first page of your last Number, is, I think, fraught with weakness and inconvenience. First, a stile of an inch thick is ill calculated to resist the pressure of the cross astragal, the firmness of which forms, I may say, the existence of the sash; there is no doubt that to assist in strengthening this, he could introduce an iron glass check in the cross bar; but as he has not told us this, he cannot claim any merit from it as part of his invention. Next, a window of the size he mentions, will require for each sash a pair of plumbs about 20 lbs. These he has to fasten to a *bit* of stick, about an inch thick, and two inches broad, grooved for his cord, and perforated for his pivot, or screw, which will reduce its strength at least one third. I would ask any thinking mechanic, if such pieces of wood so weakened, are calculated permanently to sustain a weight of ten or twelve lbs. of cast iron dangling at them, through all the endless ups and downs which a window has to undergo in a public street.

His slides I consider very objectionable; for, in addition to the trouble attending the taking them out, and putting them in, occasioned by painting, rust, and the clinging of the stiles on them—they add their mite towards weakening the already too weak stiles. In fact, I

do not see any good arising from Mr. Saul's principle, as it tends only to render a solid simple thing complex and weak. Every body knows that a window, of the very best seasoned materials, will not stand completely air and water tight above half a dozen years in exposed situations; in most cases they will then move edgeways 1-4th of an inch at the counter check, owing to the shrinking of the sash stiles and the bending of the pulley pieces, however well secured with out and inside facings. Then the consequence will be, that on Mr. Saul's plan, his slider of ½ inch broad, would be out altogether, either from the revolving or sliding stile, making, as before mentioned, a perfect *Jingle*, which even in common windows, without the aid of iron, is not very pleasant in a stormy night. I formerly mentioned, that if a little more attention was paid to hanging sashes in the common way, and fixing the batton rods so as to be easily removed, they would have all the advantages which Mr. Saul would be at, with less than one-third of the trouble. I may add another *if*, of very great consequence to the tradesman; if! he was allowed a little more for making them, he would then study improvements.

I am no prophet, Mr. Editor, but methinks I can easily predict that windows, on Mr. Saul's principles, will never be generally adopted, otherwise they must have more in them than I can see in his plans and specifications. This is the opinion of one who has made, and seen made, all kinds of sashes these 20 years past.

When I hear of, or see any thing worthy of your notice in my profession, I shall give you my plain opinion; but so far as regards the new window system, there has not any thing appeared yet that would warrant our changing the old plan.

Your's,

A JOURNEYMAN WRIGHT.

Glasgow, 13th September, 1824.

CURE FOR SCALDS AND BURNS.

SIR,—One day lately I scalded my fingers very severely, and, having somewhere heard, or seen, that a mixture of chalk and the white of eggs was a good remedy, I tried it, and found it successful beyond expectation. Indeed, scarcely had I immersed my scalded fingers into the cup, for the purpose of mixing the powder of the chalk with the glare of the egg, when I felt instantaneous relief. By applying, from time to time, a piece of linen, soaked in this simple mixture, to the part affected, the pain was gradually removed, without the application of any other plaster or remedy. Your inserting this, may be useful to those who may have the misfortune to meet with similar accidents.

I am, SIR, your's, &c.

F. B.

DRILL QUERY.

SIR,—Having a quantity of small iron castings to drill, which vary from a quarter to half an inch in thickness, I applied the drill made in the common way; but it would not pierce them, owing to the metal being so hard. Now, if any of your valuable Correspondents would inform me how the desired end is to be obtained, it will oblige,

A MECHANIC.

Carlisle, Sept. 9, 1824.

SCIENTIFIC INTELLIGENCE.

Aerial Shadows seen from the Summit of Ben Lomond.—On the 19th of August, 1820, Mr. Menzies, Surgeon, Glasgow, and Mr. Macgregor, began to ascend the mountain from Rowardinnan, about five o'clock afternoon. They had not proceeded far till they were overtaken by a smart shower; but, as it appeared only to be partial, they continued their journey, and, by the time they were half-way up, the cloud passed away, and a most delightful afternoon succeeded. *Thin, transparent vapours,* which appeared to have risen from the lake beneath, were occasionally seen floating before a gentle and refreshing breeze: in other respects, as far as the eye could trace, the day was clear and the atmosphere serene. They reached the summit about half-past seven o'clock, in time to see the sun sinking beneath the western hills. Its parting beams had gilded the mountain tops with a warm glowing colour; and the surface of the lake, gently rippling with the breeze, was tinged with a yellow lustre. While ad-

miring the adjacent mountains, hills, and valleys, and the expanse of water beneath, interspersed with numerous wooded islands, Mr. Macgregor's attention was attracted by a cloud in the east, partly of a dark red colour, apparently at the distance of two miles and a half, in which he distinctly observed two gigantic figures, standing, as it were, on a majestic pedestal. He immediately pointed out the phenomenon to Mr. Menzies, and they distinctly perceived one of the gigantic figures, in imitation, strike the other on the shoulder, and point towards us. They then made their obeisance to the airy phantoms, which was instantly returned: they waved their hats and umbrellas; the shadowy figures did the same. Like other travellers, they had carried with them a bottle of usquebaugh, and amused themselves in drinking to the figures, which was of course duly returned. In short, every movement which they made, they could observe it distinctly repeated by the figures in the cloud. This phenomenon continued at least for about a quarter of an hour. A gentle breeze from the north carried the cloud in which it appeared slowly along; the figures became less and less distinct, and at last vanished.—*Ed. Jour.*

A New Clock.—Mr. Harrison G. Dyar, formerly a Member of Middlebury College, and now a resident in Boston, has invented a clock, the machinery of which is very simple. It requires but two wheels to continue the operation eight days. Ease, strength, and uniformity, are striking characteristics in all its motions. Two clocks of this description are now in motion, at Messrs. Sawin and Dyar's clock manufactory in Boston.—*Boston Recorder*, 20*th December*, 1823.

POPULAR WORK.

We have had frequent occasion to notice some valuable productions which have made, and are about to make, their appearance in our "gude auld town." Of these, there is none, we are convinced, that will be more popular, and, above all, more useful, than a work, in the press, by our worthy and learned friend, Dr. Kennedy, to be entitled "Instructions to Mothers and Nurses on the Management of Children, in Health and Disease; comprehending Popular Rules for regulating their Diet, Dress, Exercise, and Medicines; together with a variety of Prescriptions adapted to the use of the Nursery." This work will form a fireside companion for the use of our matrons; and we have little doubt but it will ultimately supersede the well-known work of Dr. Buchan; the Domestic Medicine, though a good book in its day, yet of a truth containeth some matters much to be questioned, which, it is to be hoped, that increasing knowledge hath rendered much more plain than heretofore. The talents of Dr. Kennedy, combined with a most extensive practice, lead us to expect in his work a valuable guide to the young and inexperienced mother, and a constant reference book for the heads of families, as well as for the young practitioner in this department of medical science.

NOTICES TO CORRESPONDENTS.

J. Pearce, and James Jones, have been received.—G. M. will find a shorter mode, than he proposed, in our next.—If Mr. Alexander Buchanan, of Paisley, would be so good as to send us a description of the invention, or manufacture, mentioned in his certificates, they will be readily inserted.—D. A. N. will be inserted on the first opportunity.—J. F. would oblige us by sending a more distinct account of his Hoop Problem.

☞ No. XXXIX. for next week, will contain, among other interesting Articles, an Account of the Dredging Machine on the River Clyde, a Review of Dr. Ure's "Berthollet on Dying," with interesting extracts, an Address to Working Mechanics on the Combination Laws, a Review of "Roberts' Mechanics' Assistant," &c. &c.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written. Original Patents, Inventions, &c. will be inserted on the shortest notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of Steuart & Panton, Cheapside, London; and Edward West & Co. Edinburgh.

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THE GLASGOW
MECHANICS' MAGAZINE.

" An intimate knowledge of the Arts, has a softening influence on the manners, and prevents them from becoming fierce."—*Ovid.*

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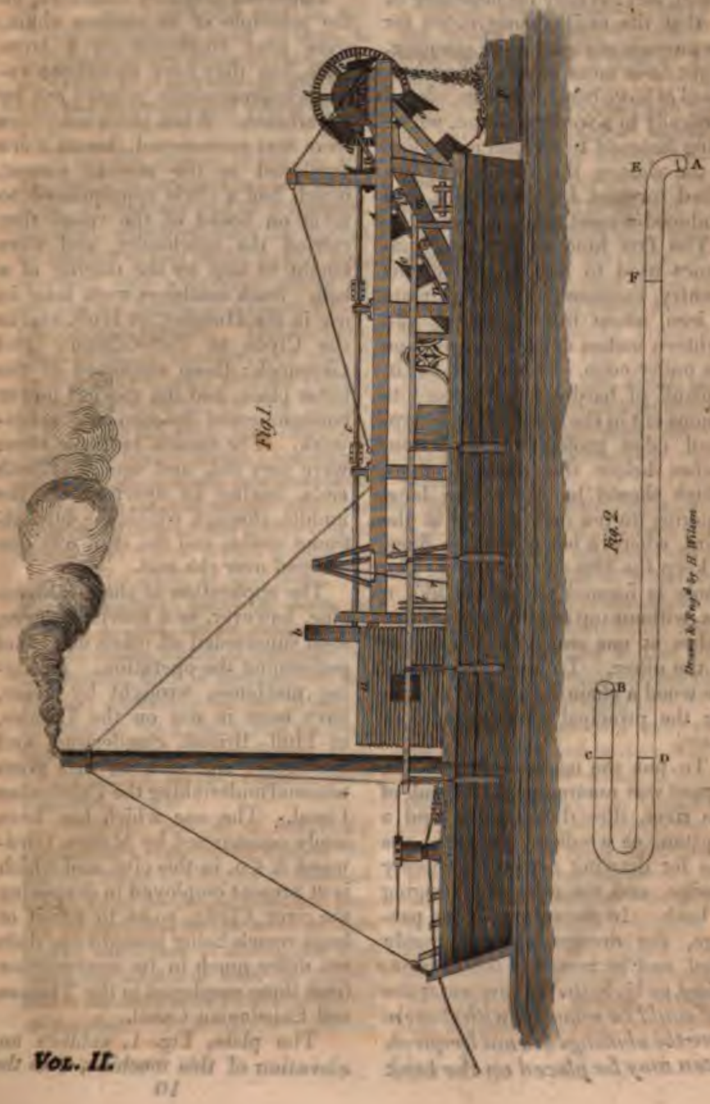
DREDGING MACHINE ON THE RIVER CLYDE, &c.



ON DREDGING MACHINES.

With a Description of One at present employed to Deepen the River Clyde.

Dredging was first employed by the Dutch to clean the bars or entrances of their harbours and navigable canals. The first machines were not contrived for lifting mud, gravel, &c. but only for loosening it, so that the sluices constructed for the purpose of cleaning, or scouring, might have more effect. They consisted of large bars, or prongs, placed vertically in a wooden frame, which being fastened to a vessel in the line of the sluices, the whole was impelled forward by the current, and produced a most effectual scour.

The first kind of dredging machines used to any extent in this country, consisted of a large plate of iron, about four feet long, and eighteen inches deep, sharpened on the under edge. To each end of it, a plank of hardwood was fixed to tenons cut in the iron, whose sharpened edge projected about four inches below the wooden sides, which should be about five long, tapering to ten inches deep at the point, where a bar of iron is fixed to keep the two ends asunder. The whole is formed somewhat like a box, without top or bottom, eighteen inches at one end, and ten inches at the other. To the two ends of the wood a chain is fixed for attaching the principal working rope, or chain.

To put the machine in motion, a punt was moored on each bank of the river, directly opposite, and a capstan, or windlass, on each, the one for drawing across the empty dredge, and the other for bringing it back. In the course of its passage, the dredge was commonly filled, and by means of the capstan, raised so high, that at low water the stuff could be removed with shovels. Where the shiftings are not frequent, a capstan may be placed on the bank of the river, and the operation carried on as described. Machines on this principle were employed for many years in deepening the Clyde between this city and Dumbarton.

Improved dredging machines, on the principle of an endless chain, were next employed on a large scale, but they have undergone various improvements pointed out by experience. When these machines were first constructed, horses were employed as the moving power, which had a circle appropriated to them on board of the vessel that carried the machinery, and were taught to stop by the ringing of a bell. Such machines were long in use in the Humber, at Hull, and in the Clyde at Port-Glasgow and Greenock; those employed at the latter place, had the moving power communicated by men and crane-work. The vessels built for them were very flat, and square at both ends, having an aperture up the middle, through which the bucket-frame works, and the stuff was discharged over the end.

The application of the steam-engine, however, as a moving power, soon superseded all other modes of performing the operation. Dredging machines, wrought by steam, have been in use on the Thames, at Hull, Bristol, Sunderland, and Aberdeen, and also on that great national undertaking the Caledonian Canal. The one which has been lately constructed by Messrs. Girdwood & Co. in this city, and which is at present employed in deepening the river Clyde, so as to admit of large vessels being brought up, does not differ much in its construction from those employed in the Thames and Caledonian Canal.

The plate, Fig. 1, exhibits an elevation of this machine, with the

vessel which contains it. The dredge is situated, in this machine, in the centre of the vessel, which has an opening of about two-thirds of its length from the stern, to allow the machine room to touch the bottom to be deepened. The space on each side of this opening in the vessel is fitted up with hammocks, &c. for the accommodation of the workmen. The remaining part of the vessel towards the head or bow, is occupied by the steam engine, boiler, stalk, &c. and the dredge discharges the mud and gravel at the stern.

When the engine is set on, the motion is communicated to a wheel fixed on the near end of a horizontal shaft, which conveys the motion to another wheel at the farther end, working into a bevelled wheel on the square barrel or axis on which the buckets revolve. The buckets, twenty-two in number, are placed on the links of two endless chains, connected together by the fastenings of the buckets, and revolving round the bucket frame; the length of each link is made to correspond to the side of the square barrel or axis, revolving in the upper end of the bucket frame, which is supported on the deck at the stern. A similar square barrel or axis, is placed at the lower end of the bucket frame which is immersed in the water, and is elevated or depressed according to the depth of the bottom by a chain and pulleys, the end of which terminates in a barrel turned by the engine, when required.

When the process of deepening commences, the lower end of the bucket frame is allowed to descend till it touches the bottom, so that when each bucket arrives at this end of the frame, it scoops out and takes up a load of mud or gravel, and is carried round by the revolving of the chain. This chain, when loaded with the buckets, is supported on the upper side of the bucket frame, by means of a series of rollers, which prevent the great friction which would otherwise be occasioned by the dragging of the heavy buckets on the frame. As each bucket passes over the upper end of the frame, it discharges its contents into punts brought a-stern of the vessel.

While this process is going on, the vessel is made to move forward by means of a capstan slowly wrought by four men. This capstan winds in, a chain made fast to an anchor considerably a-head of the vessel. The punts are first loaded on the one side, and are then turned round to receive a load on the other; when full, they are floated away to the edge of the river, whence the stuff taken out of the bottom is laid along side of its banks. The quantity brought up at any time must vary considerably from the nature and depth of the bottom; we have heard it stated, that 30 tons have been raised in 7 minutes, in favourable circumstances.

In Fig. 1, *a*, is the engine-house; *b*, a covered wheel, communicating motion from the engine to the shaft *c*, on the other end of which is the shaft wheel *d*; *e*, is the square barrel or axis, on which the buckets *o*, *o*, *o*, revolve; *m*, is the bucket frame; *n*, the double endless chain; *i*, *i*, the friction rollers; *r*, *r*, the regulating chains and pulleys; *l*, the levers for communicating motion to the barrel which moves the chain and pulleys; *p*, situation of the punts when receiving the mud or gravel raised from the bottom.

In the dredging machines used in the Thames, there are two dredges, or endless chains with buckets, one on each side of the vessel, working on the outside, which prevents the necessity of an opening in the centre as above.

MR. WESTLAND'S INVENTION,

For Ascertaining the DIFFERENT STRENGTHS of equal quantities of all kinds of GUNPOWDER.

PROVIDE a curved glass tube, open at both ends, tolerably thick, and about one-fourth of an inch in diameter; into which put running mercury to the height of three to four inches—as is represented by C D, fig. 2. Pour into the leg A as much water as it will contain, and into the space B C put a quantity of gunpowder equal to that of the next you intend to try.

It is evident, that when the gunpowder is kindled at B, the whole quantity contained in B C will dilate equally in all directions; therefore it will push against the mercury D C, and consequently raise the column of water in D A; a quantity corresponding to this force will be thrown out, but cannot return owing to the curvature at A E; but all that is below E may perhaps return to the point F; hence F E being greater or smaller, will ascertain the explosive force of the loose powder put into B C.

Your's, &c.

JAMES WESTLAND.

Charlestown, by Dunfermline, 1st September, 1824.

SKETCH OF THE HISTORY OF PHILOSOPHY,

Particularly with reference to Mathematical and Mechanical Science.

(Continued from page 137, Vol. II.)

THALES was the first of the Grecian philosophers, who signalized himself by his skill in the mathematical and philosophical sciences. He was a native of Miletum, where he was born about 640 years before the Christian era. After spending a large patrimony, and many years of his life in foreign travel and the acquisition of knowledge, he returned to his native land fraught with all the learning of Egypt. He transplanted from that degraded country those sciences which were on the point of being perhaps for ever lost to mankind, to a soil the most fertile and productive in the world. It is reported that Thales acquired the principles of Astronomy, Geometry, and Natural Philosophy, from the Egyptian Priests; that he submitted to be initiated into their religious rites, of which he probably saw the folly, for the purpose of gaining a knowledge of these sciences; that he was in favour with the king of the country, and lost it owing to the freedom of his remarks on the conduct of those who ought to be the shepherds of their people, but who frequently turn out the mere appropriators of their property.

This indeed might occasion his return to his own country, as the machinations of the Priesthood, or the Court, which are generally enemies to true science, would be directed against the illustrious stranger, who had braved the dangers of the wild and the ferocity of the savage, in the pursuit of knowledge. Happy may we in this age esteem ourselves to be, that, having the collected treasures of antiquity, which have been accumulating for ages, in our possession, we may sit every one at his own fire-side, and in a few hours learn those truths which cost the first inventors the labour and the travel of years. Let no one despise his privileges, but

endeavour to improve himself in, or make himself acquainted with, that species of knowledge, which only renders the human species worthy of the name.

His inventions and improvements in Geometry were many, considering the rude state of the science; and the doctrine of triangles is perhaps indebted to him for its foundation, or at least considerable extension. He is credibly reported to have been the first, even in Egypt, who found the height of the pyramids by means of their shadow. How feeble, then, must have been the knowledge of the Egyptians, if it had not wonderfully degenerated, when an operation, which now could be performed by any school-boy, was reckoned a wonderful achievement.

Thales laid the foundation of Astronomy; he divided the celestial sphere into the five circles and zones; the arctic and antarctic, the two tropics, and the equator. He made observations on the apparent diameter of the sun, and formed the constellation of the Bear. He was the first philosopher who calculated and foretold an eclipse, which, as Herodotus relates, happened on the same day, and at the same instant, that a battle was fought between the Lydians and the Medes. He divided the year into 365 days, and taught that eclipses of the sun were occasioned by the intervention of the moon, and those of the moon by the intervention of the earth.

His knowledge of mechanical contrivances, which he no doubt owed to that of mathematics, instructed him how to enable king Croesus, marching with a powerful army into Cappadocia, to pass the river Halys without a bridge. A pleasant story is related of him, that while walking out one night and contemplating the stars, he fell into a ditch; on which an old woman exclaimed, "How canst thou know what is passing in the heavens, when thou seest not what is at thy feet?" This philosopher, who founded the Ionian sect, and was accounted one of the seven wise men of Greece, died at the advanced age of ninety years, while present at the Olympic games, loaded with renown, which he chiefly owed to his mathematical skill.

Anaximander and Anaximenes, of whom the former was the disciple, and both were the successors of Thales in the Ionian school, taught the same doctrines, with some modifications. Anaximander is said to have been the first who discovered the obliquity of the ecliptic, which he made at that period 24^{0}. He drew up the first geographical table, invented the gnomon, and set up the first sun-dial at Lacedæmon. He taught that the earth was globular; and to him is ascribed the invention of the sphere to *represent* the heavens, and the construction of charts. Anaximenes continued the knowledge delivered to him by these philosophers, but seems not to have added much of his own.

The philosophy of these three early sages, appears to have been very aspiring. From the accounts which have been preserved of their opinions, we learn that they invented theories and systems of the universe, and pretended to explain the origin and the formation of all things. "Such bold speculations flattered human vanity, and charmed the imagination by a glittering semblance of truth. Their philosophy supposed every substance whatever to be composed of four elements—*earth*, *water*, *air*, and *fire*, merely combined in various proportions. Earth and water they viewed as naturally ponderous and inert, while they fancied air and fire, endued with elastic virtue, to

possess lightness and activity. While the earthy matter settled toward the centre of the world, and the aqueous fluid rolled along the surface of the globe; the air and fire soared aloft the former, occupying the whole region below the moon, and the latter streaming through the boundless extent of space. The same pure lambent fluid, being collected into globular masses, formed the groupes of stars. But portions of its divine essence descended, to animate the subjects below, and communicate the vital spark. Such visions, so like the colouring of fantastic dreams, were yet firmly believed in former ages, they became afterwards incorporated with the vulgar creed; and still deeply tincture the language of poetry."

Anaxagoras, who continued the succession of Ionian schools, rose to higher eminence. He relinquished the ease which a splendid fortune promised to afford, and dedicated the best portion of his life to the pursuit of knowledge, under the Priests of Thebes and the Magi of Persia; and, on his return to Greece, he was induced, from the dread of foreign conquest, to transfer the school of Ionia to the renowned city of Athens. His eloquence and learning made a powerful impression on the inhabitants of that intellectual city. But he drew upon himself the odium of the illiberal, by broaching some opinions at variance with the received notions, though anticipating obscurely our modern discoveries. Condemned to die by the fury of an ignorant priesthood, and the bigotry of a popular government, he supported the relation of the fact by a friend, with the calmness of a true philosopher, saying, "Nature long ago pronounced the same sentence against me." Afterwards, when he was told that the sentence was converted into banishment, and the friend who informed him expressed his regret at his leaving the city, he replied, with a mixture of fortitude and conscious worth, "It is not I who have lost the Athenians, but the Athenians who have lost me." When he died he was honoured with a tomb and epitaph, and two altars were erected in his name, one to *truth* and the other to *mind*.

Such has ever been the case with the master spirits of mankind. Neglected or persecuted by the age in which they lived, and to which they were so great an honour, no sooner were they entombed in their graves, than the tide of the kindlier feelings returned with a full but unavailing flow, and spent itself in raising idle monuments to names more imperishable than the world itself.

> "While kings in dusty darkness hid,
> Have left a nameless pyramid,
> Thy heroes, though the general doom
> Hath swept the column from the tomb,
> A mightier monument command—
> The mountains of their native land!
> There points thy Muse to stranger's eye,
> The graves of those that cannot die!"

The island of Samos had at length the honour of giving birth to Pythagoras, the first sage who took the modest but auspicious name of philosopher, that is, *lover of wisdom*. He was born about 590 years B. C. Nature bestowed on him her choicest gifts, and assiduous cultivation heightened all those qualities in him, which are calculated to command the minds of men. Pythagoras, like Anaxagoras, sacrificed his ample fortune, and devoted the best part of his life to the acquisition of knowledge. He was admitted into the sacred college at Memphis; he resided some time in Phenicia; visited Persia, celebrated for her wise men, and pursued his oriental journey as far as the banks of the Indus. After an absence of nearly thirty years, he returned to his native land, fraught with the

learning of the East, and was viewed with awe and reverence by his assembled countrymen at the Olympic Games. He began to give instructions in his native island, Samos, but soon removed, on account of tyranny, which is so unfavourable to genius, to the Grecian colony planted at Tarentum, on the coast of Calabria, in Italy. In that voluptuous city he collected numerous pupils, and founded the powerful school of Pythagorean Philosophy, which existed for some centuries after his death. It is said that he enjoined his scholars a five years' silence in the school, during which time they had only to hear; but, when this period was expired, they were allowed to start questions and propose doubts, with this caution, "To say *not* a little in many words, but a great deal in a few." He was not only a philosopher, but a hero of the truest kind. He wrote books on natural philosophy, morals, politics, and theology. His mathematical discoveries and his golden verses are, however, all that remain. He delivered several cities of Italy and Sicily from the yoke of slavery; he appeased the rage of sedition; he softened the manners and soothed the temper of the most savage and unruly spirits of the people and of tyrants. Phalaris, one of the latter, was so enraged at his discourses, that he ordered him to be put to death. The tranquillity of the philosopher, had more effect than the wrath of the tyrant; the latter fell on the very day fixed for the commission of such an atrocious crime.

Not to shock the prejudices of his countrymen, Pythagoras judged it expedient to separate the doctrines he taught into two distinct sorts—viz. the *Exoteric* and the *Esoteric*. The former consisted in discourses, addressed to the people in the temples, and other places of public resort, calculated to reform their habits and dispositions; the latter comprehended those mysterious principles communicated only to the very few disciples who, after a long and severe probation, were esteemed safe and fit depositaries of such truths. He strenuously urged the study of mathematics, especially those branches which refer to numbers and proportion. He made very important advances in these sciences himself, and such as would have alone conferred immortality on his name. In arithmetic he invented the common multiplication table; and in geometry discovered three wonderful propositions—*viz.* 1. That only three regular plane figures can fill up the space about a point, *viz.* the equilateral triangle, the square, and the hexagon. 2. That the sum of the three angles of every triangle is equal to two right angles. 3. That in every right angled triangle the square on the longest side is equal to the sum of the squares on the other two sides. 47. 1. E. The discovery of this last theorem is said to have excited in his mind such extatic and devout feeling, that he sacrificed a hecatomb, *i. e.* a hundred oxen, to the Gods on account of it, conceiving its discovery in the light of a revelation from heaven. Besides the Pythagorean table, arithmetic was enriched by many fine discoveries of this philosopher and his pupils. The various contrivances which they fell upon for want of a regular system of notation, renders it probable that they performed many of their calculations by mere dint of thought, and without the aid of visible signs. This abstraction might lead to the necessity of accustoming the young student to silence, when the utterance of a single word might have occasioned the most intricate mental calculation, when brought near to a

close, to vanish like a dream from the grasp of the calculator. Though the object of research which the Pythagoreans held in view, in their numerical speculations, might be often imaginary, and even absurd, yet their labours must not be considered as wholly barren and unfruitful. The first efforts of science must be stimulated by the prospect of advantages sometimes entirely fanciful; but time ultimately separates the truth from error. The alchemists did not discover the philosopher's stone, or a universal elixir; yet, in their researches after these ideal substances, they laid the foundation of chemistry, and made valuable additions to the healing art.

Pythagoras, having his imagination full of numerical relations, on them he founded the theory of music, which he cultivated both as an art and a science. But he transferred his ideas of music to the harmony of the celestial motions. Rising, as one has finely expressed it, to the sublime conception of the true system of the universe, he seemed to have veiled that noble discovery under a beautiful allegory. Under the symbol of Apollo playing on the lyre, he taught his chosen disciples that all the planets, including likewise our earth, are inhabited worlds, which revolve about the sun as their common centre; and he farther maintained that these bodies, while they circle round the great luminary, perform a most harmonious concert, but that such ravishing and heavenly sounds are lost to our gross ears, and drowned amidst the jarring sounds that prevail below. He discovered that Lucifer and Hesperus, or the morning and evening star, two names applied to the planet Venus, and thought to be two different stars, or planets, were but one and the same planet in different situations. From him, in fine, it is supposed that Copernicus, at the distance of many centuries, borrowed the true theory of the universe.

(To be continued.)

BERTHOLLET'S ELEMENTS OF THE ART OF DYEING,

With a Description of the Art of Bleaching by Oxymuriatic Acid.—Second Edition, Translated from the French, with Supplementary Notes and Engravings. By Andrew Ure, M. D. F. R. S. Professor of the Andersonian Institution, Glasgow.—2 vols. Tegg, London. Griffin & Co. Glasgow, 1824.

A new translation of an improved edition of a work, so well known and so highly valued as the one before us, must be a useful acquisition to the manufacturer and the dyer, especially when we consider the acknowledged abilities of the translator. To the original work, he has added no less than 138 pages of new and valuable matter, containing details of the most remarkable chemical researches connected with dyeing and dye-stuffs, which have recently appeared in scientific journals; to these are added some valuable extracts, from original and foreign works, on the Adrianople madder-red, and calico-printing, with some useful observations, made public for the first time; and, to render the work a valuable standard reference book on the art of which it treats, the translator has furnished engravings and descriptions of the most useful machines at present employed in our best dyeing establishments, to which he had the privilege of free access.

The work itself has been formerly in the hands of the public, and must therefore be well known to many; the improvements in this edition, however, deserve to be noticed; and, indeed, from the additions which the translator has found it necessary to make, it might be suggested that he would perhaps have done better had he written an original work, taking his present author for his standard, and modifying and accommodating the whole to modern practice. Be this as it may, the work of Berthollet must still remain the most complete treatise on dyeing yet offered to the public. From the notes of the translator we extract the following account of the variations in the mode of dyeing Turkey-red, from that given by the author.

THE first person who established, in this country, a factory for dyeing the Adrianople madder-red, was M. Papillon, who, in the year 1790, obtained a premium from the Commissioners and Trustees for Manufactures in Scotland, for communicating the details of it to Dr. Black, on condition that it should not be divulged for a certain term of years, during which M. Papillon was to have the sole use of his own secret. The term being expired, the process was published. It resembles pretty closely the method described in the text by M. Berthollet. Those who wish to compare them, will find M. Papillon's in the 18th volume of Tilloch's Magazine, p. 43.

M. Vitalis, in his valuable treatise on dyeing, published in 1823, *(Cours Elémentaire de Teinture,)* has entered at considerable length into the description of the Turkey-red dye, with which his situation at Rouen had made him familiar. I shall here note those points in which he appears to differ from M. Berthollet, or is more precise.

In the *second* operation, he states, that from 25 to 30 pounds of sheep's dung are commonly used for 100 pounds of cotton yarn. The dung is first steeped for some days in a ley of soda, of 8° to 10°. This is afterwards diluted with about 500 pints of a weaker ley, and at the same time bruised with the hand in a copper basin, whose bottom is pierced with small holes. The liquor is then poured into a vat containing five or six pounds of fat oil, *(Gallipoli,)* and the whole are well mixed. The cotton is washed in this, as prescribed by M. Berthollet. The hanks of cotton yarn are then stretched on perches in the open air, and turned from time to time, so as to make it dry equally. After receiving thus a certain decree of desiccation, it is carried into the drying house, which is heated to 50° Reaumur, (144° Fahrenheit,) where it loses the remainder of its moisture, which would have prevented it from combining with the other mordants, which it is afterwards to receive. What is left of the bath is called *avances*, and is added to the following bath. Two, or even three dung baths, are given to the cotton, when it is wished to have very rich colours. When the cotton has received the dung baths, care must be taken not to leave it lying in heaps for any length of time, lest it should take fire; an accident which has occasionally happened.

Third Operation.—Oil or White Bath.

This bath is prepared by pouring in six pounds of fat oil, fifty pints of soda water, at 1° or sometimes less, according as, by a preliminary trial, the oil requires. This bath ought to be repeated two, three, or even a greater number of times, as more or less body is to be given to the colour.

Fourth Operation.—Salts.

To what remains of the white bath, and which is also styled *avances*, about 100 pints of soda ley of two or three degrees are added. Through this the cotton is passed as usual. Formerly, it was the practice to give two, three, or even four salts. Now two are found to be sufficient.

Fifth Operation.—Degraissage.

The cotton is steeped for five or six hours in a tepid solution of soda, of 1° at most; it is set to drain, is then sprinkled with water, and at the end of an hour is washed, hank by hank, to purge it entirely from the oil. What remains of the water of *degraissage*, serves for the scouring or *first* operation.

Sixth Operation.—Galling.

For 100 pounds of cotton, from 20 to 25 pounds of galls in sorts must be taken, which are bruised and boiled in about

100 pints of water, till they crumble easily between the fingers. The galling may be done at two operations, dividing the above quantity of galls between them, which is thought to give a richer and more uniform colour.

Seventh Operation.—Aluming.

The aluming of 100 pounds of cotton requires from 25 to 30 pounds of pure alum, that is, alum entirely free from ferruginous salts. The alum should be dissolved without boiling, in about 100 pints of river or rain water. When the alum is dissolved, there is to be poured in a solution of soda, made with the sixteenth part of the weight of the alum. A second portion of the alkaline solution must not be poured in till the effervescence caused by the first portion has entirely ceased, and so in succession. The bath of saturated alum, being merely tepid, the cotton is passed through it, as in the gall bath, so as to impregnate it well, and it is dried with the precautions recommended above. The dyers who gall at two times, alum also twice, for like reasons.

Eighth Operation—Washing away the Alum.

Ninth Operation.—Maddering.

For 25 pounds of cotton, 25 pints of blood are prescribed, and 400 pints of water. Whenever the bath begins to warm, 50 pounds of madder are diffused through the bath. Sometimes the maddering is given at two operations, dividing the madder into two portions.

Tenth Operation.—Brightening.

The brightening bath is prepared always for 100 pounds of cotton, with from 4 to 5 pounds of rich oil, 6 pounds of Marseilles white soap, and 600 litres of soda water of 2°.

Eleventh Operation.—Rosing.

This is done with solution of tin, mixed with soap water.

Two systems for the Turkey-red are known at Rouen. The first is called the *grey* course, the second the *yellow*; (*marche en gris*, and *marche en jaune.*)

The *grey* course takes its name from the cotton being subjected to the maddering immediately after it has received the oily preparations, and the mordants of galls and alum, which give it a *grey* colour.

The *yellow* course is so called, because in this system the cotton, after having received a first time the oily preparations, as well as the mordants of galls and alum, is *not* exposed to the maddering till it has passed a second time through the same preparations and the same mordants, which gives it a *yellow* colour. It is this second manner of working the Turkey-red, which is called, in the phraseology of the dye-house, *remounting on the galls.*

The following table exhibits the difference which exists between these two courses:—

Grey Course.	*Yellow Course.*
Boiling	Boiling
Dung baths	Dung baths
White baths	White baths
Salts	Salts
Degraissage	*Degraissage*
Galling	Galling
Aluming	Aluming
Washing off the alum	Washing off the alum
Maddering	White baths
Brightening	Salt
Rosing	Degraissage
	Galling
	Aluming
	Washing off the alum
	Maddering
	Brightening
	Rosing.

The grey course, as well as the yellow, is susceptible of a great many combinations and varieties, both in the order and number of the operations, relative to each.

(To be continued.)

ADDRESS ON THE REPEAL OF THE COMBINATION LAWS.

MECHANICS OF SCOTLAND,

BY the Repeal of the Combination Laws, a wise and upright measure of the present very popular administration of our country, you have been favoured with a degree of liberty unknown for many years, and we would therefore seriously recommend you to avoid an error into which you are liable to fall, namely, an abuse of the privileges which

een thus granted to you in com-
vith your masters. Haters, as
, of oppression in every form, we
but rejoice that you have at last
d a power of preserving your-
in future from any unjust or
measures that might be attempted
you, or that might prevent you
aining a decent and respectable
od. On the other hand, how-
s we are equally haters of licen-
ss in every form, we would sin-
regret any appearance of a spirit
bordination, or of improper re-
n, among those who may have
l, perhaps severely, from the ef-
f those laws, which, by their re-
re acknowledged to have been
us to the interests of the country,
just to a class of men who are
s pride and support.

of the greatest importance to ob-
that while your liberties have
creased, your responsibility has
en diminished; and that, while
s you may be of enjoying and
use of your privileges, you ought
re of the opposite extreme, name-
t of abridging those of others.
st be perfectly aware, that we ad-
u with some examples already be-
r eyes, of the want of that prudent
which we thus so sincerely re-
nd. Men, ignorant of the Act
contains the repeal of the combi-
laws, or desirous of misinterpret-
obvious meaning of the statute,
ave been led, or may have led
to go beyond what it warrants
o do; and thus not only to trans-
ts obvious injunctions, but to
hemselves under the penalty in-
upon the transgressors. It is
ent this, that we are thus anxious
ess you on a subject, which must
our own welfare in a very great
e, according as the views which
ve taken of it, may be well or
ded. No one, we are sure, who
y reads the Act, or hears it read
rom beginning to end, will ever
e that he may combine to leave
k, which he has agreed to per-
r to cause others to do the same,
revent them from taking work
hey are willing to do it, without
ng the express terms of the sta-

we are not, we are sorry to say,
very recent examples of such
infringement, and the consequent punishment thereunto attached. Now, we would ask, where was the usual caution which is the characteristic of our nation, when some members of a very worthy and industrious class of our mechanics, so far forgot themselves as to proceed upon alleged erroneous information, or foolish and perhaps interested advice, to act contrary to the express terms of the statute? Ought they not first to have made themselves sure of the ground of their proceedings? Could they not procure a copy or an abridgement of the Act? Or, was it expressed in such obscure and ambiguous terms, that they could make no other meaning of it but what was manifestly erroneous?

Combination, in itself, is evidently no crime, unless it be for illegal purposes. Now, will any one pretend to say, that a combination to put an individual out of trade, is not an unjust and illegal purpose? Combination to raise wages, is not illegal; it is permitted by the Act,* and accords with the principles of justice between man and man, especially when it is considered that those wages are too little, and such as a man cannot live upon—combination to lessen or alter the hours of working, is not illegal, because it is permitted by the Act, and accords also with the natural principles of justice, especially when those hours of working are injurious to health, and calculated to bring the poor working mechanic speedily to his grave—combinations to effect any of these or similar purposes, by fair and open agreement amongst each other, without force, compulsion, or intimidation, against those who are unwilling to join, is not illegal, because it is permitted by the Act, and is consonant to the principles of common sense.

Combination, however, for effecting any of the above purposes, by violence to person or property, by threats or intimidation, either in word or deed, is not only illegal and contrary to the express terms of the Act, but is evidently contrary to the first principles of natural liberty, which allows every man to do what he will with his own, and to serve or not serve any master he chooses, for whatever wages he thinks proper; or, if he should take a fancy for it, for no wages at all. What can be more absurd, than to prevent one individual

* See "Abstract," by W. R. M'Phun, Glasgow.

from working to a master, because another thinks that he has too little wages for his work? If the man who is willing to work does not think so himself—or, at least, does not think they are so low as to prevent him from agreeing to his master's terms—what right has another to prevent him from accepting them? Any man would think it exceedingly absurd, were another to come into his house and interfere with his domestic affairs; and yet, if he prevents him from working to a particular master, or for particular wages, he not only effectually interferes with his domestic affairs, but does all he can to ruin his family by depriving him of the only means of supporting them; he, in fact, does more harm than if he were to walk into the house of the unoffending man, and break all the little articles he could find in his cupboard or kitchen-shelf; these could soon be replaced by his daily industry, but how could the reward of that industry be obtained, if he were prevented by the absurd folly of others from exerting it?

Combination for the purpose of compelling any master, by threats, orders, rules, or any other mode, to alter or regulate the affairs of his business, or to employ certain individuals as foremen in preference to others, is manifestly illegal, contrary to the terms of the Act, and against the principles of liberty which ought to pervade the inhabitants of a country increasing in knowledge, and celebrated over the Continent for the learning and wisdom of its lower classes. Would not any mechanic think it absurd, if any master should interfere with the regulation of his private affairs at home, and prescribe to him certain rules which he was to follow there, and certain people which he was to employ in the management of those affairs? And yet what does a mechanic do who wishes to cause his master to act according to the dictates of those who are not only ignorant of the nature of the business, as a whole, but who have, besides, no right to interfere with the management of what does not belong to them? That golden rule, "Do as you would be done to," though implanted in the mind of man, as an axiom of common sense, or self-evident truth, as broad and bright as the noon-day, seems, uniformly, by some stupid fatality belonging to the human race, to be forgotten and obscured, as it were, by a total eclipse, whenever self-interest, real or imaginary, begins to be the sole regulator and main-spring of our actions.

Then, indeed, blinded by an overweening love of self, and looking only at the one side of a question which affects our own welfare, we entirely disregard the duties and the considerations which we owe to others. And, it is not until some foolish or fatal action has been committed that we begin to reflect how far we ought to feel for others, by putting ourselves in their situation in imagination, and then confessing that we should not really like to be so treated, or that perhaps there is some injustice in acting towards a person in a way which we would not like or expect, were we called upon to suffer it ourselves. Were both masters and workmen more frequently to think of these things, they would not have so much occasion to complain of each other. That masters have, in many instances, acted unjustly towards their workmen, is a truth that cannot be denied; but, on the other hand, it must be allowed that the latter have also, in many instances, acted unjustly towards the former. If either have been the case, however, in any instance, it ought to be remembered, that retaliation, when in your power, is an inglorious thing; and, besides, is extremely liable to be more severe than the first offence. It should be remembered, that "it is the glory of man to pass over a transgression," and that

"To err is human, to forgive divine."

Besides, the faults or offences of another will in no case justify our conduct if we act in a similar manner. It is a common and a true proverb, that "Twa blacks will not mak ae white." Hence it is obvious, that if we plainly transgress the express terms of a new statute, it will not be an excuse for our conduct to allege, that we are merely treating others in the same manner as we ourselves were formerly treated.

A new law never has, and ought never to have, a retrospective effect: if, then, a new law be issued respecting two classes of men mutually dependent on each other, affording the same liberties and privileges, but forbidding, under severe penalties, every thing like quarrel, threats, or violence, either on one side or other, it is manifest that that class which first transgresses the salutary regulations of

such a law, is entirely in the wrong. But it is matter of wonder, that those who are mutually dependent on each other, should ever have occasion to disagree so far as to put a stop to that on which they both depend. What could the workman who has ceased to work to his master ultimately do? He must work either sooner or later, or else be deprived of the means of subsistence. He has no store of money or property laid up, by which he can support himself in idleness; and it is evident, that if he holds out long, want must at last stare him in the face. This is not all: his wife and family will suffer along with him; and, disappointed of his weekly pittance, they may be pining away with hunger, and grieving at his obstinacy in refusing to work when it is in his power.

In hard times it is difficult to get work, and it is reckoned a blessing by the industrious man when he can get it; what, then, must be the folly of those who despise work, and throw it up when they have it, for the sake of entering into a foolish combination to obtain what it is likely they will not obtain, at least, by such violent means. On the other hand, it may be asked, what could the master who has been deserted by his workman ultimately do? He will, no doubt, be longer independent of his workmen than they could be of him; but he must, sooner or later, fall. He may have a stock of unpaid material on hand, which, if not converted into goods, and returns received for it, may produce bankruptcy, and all its attendant miseries—miseries which far surpass those which befal the working man when thrown out of work. He may have involved not only his own property, but that of many others, in his establishment; and if, by a sudden determination of the workmen to strike work, the manufactory which he is carrying on is made to cease, there may be the most imminent danger of the whole being rendered useless in a mercantile point of view, and being left as a dead stock upon his hands. Others, taking advantage of his cessation, may overstock the market where his goods are sold; and, while they are making a fortune by the increased demand for their own goods, which find their way into the market from the absence of those of an extensive competitor, he may be suffering all the horrors of impending and irretrievable bankruptcy.

And, when reduced to poverty, what can a master do more than a servant? They are then upon the same level; nay, the former is in a worse condition than the latter. The servant can work to any master, and he can even change his labour, but, in most cases, the master cannot work at all; he is, therefore, more dependent than the workman. In fact, in the actual and abstract state of man, the workman is the most independent man alive—his hand can always procure him the necessaries of life; but wo be to him who depends upon riches, "for they make unto themselves wings and flee away."

We formerly supposed a case where an unjust attempt was made, by combination, to put an individual out of trade; let us now suppose a case in which an equally unjust attempt was made, on the part of masters, by combination, to prevent a workman from procuring work. What would be the consequence? The individual would go from warehouse to warehouse, seeking work, and unable to find it. Every door is shut against him—every ear is deaf to his cry. He might say, "Give me work, else I starve." No kind hand presents it to him. He returns home, desponding, to his wife and children—tells them that an unjust combination has been formed against him, which prevents him from getting work; he has now no money—no food to give them; the lamentable and united cry of misery rises up in their once happy dwelling; and it is only by a providential turn in their favour, that they are prevented from absolute desperation and the awful alternative of dying for hunger.

In the case of the manufacturer, deserted by his workmen, or prevented, by an unjust combination of workmen, from employing those who are willing to work, he must give up business; and the same consequences which we have above described must follow, though, no doubt, in his case more slowly, but not the less surely. The general odium which would attend such an individual, would be more hurtful to his feelings and to his condition than those of the workman. The former is held up to public view by such proceedings, the latter is protected by his obscurity; the former may be ruined in happiness and prosperity, the latter

cannot be so deeply affected in either; the former may seek in vain to re-establish himself in business, the latter may find both work and happiness unknown to the world and to his persecutors.

From the whole view of these cases, and many others which might be enlarged upon, it is manifest, that both masters and workmen mutually depend on each other, and that to attempt to separate their interests, is not only absurd but impossible. The old fable of the belly and the members, has been often quoted, especially in political affairs, and it may not unfitly be pressed upon the notice of those who are unable to follow reasoning without allegory. The workmen are the members, and the masters are the belly; it is therefore as absurd for the workmen to suppose, that they may act as if they were independent of their masters, as it would be for the members, as they once did according to the fable, to refuse to work for the support of the belly. For, if the workmen give up labour for the support of their masters, they give up labour for their own support; and they will, like the members who despised the belly, pine away and die for want of the support and nourishment they receive from their masters. That the masters are apt to neglect the state of their workmen, is a fact which cannot be denied; for, if the workmen were sufficiently paid, or well-treated, they would then have no cause to complain. The ancient allegory might be here reversed to illustrate the case, and we might suppose that the belly, once on a time, refused to support the members; the consequence would be, that the members would not be able to support it, and would thus bring ruin on the belly by its own folly.

We conclude, from the whole subject, that mechanics ought to be very cautious in their proceedings, lest they misinterpret or misunderstand the nature of the Act, and lest they should subject themselves to the punishment which has been already awarded, in cases to which we formerly alluded. They ought also to remember, that though the sentence, in these first cases, was awarded with a praise-worthy leniency, and considerably below the letter of the Act, yet those who may disregard the injunctions of the statute, in future, may not be so mildly dealt with by other Judges who may be appointed to decide on such cases; indeed, we sincerely hope that they will never again occur, and that the working mechanics of Scotland will show that they know how to use the liberties which have been granted them in the purest spirit of political justice.

ROBERTS' MECHANICS' ASSISTANT, OR UNIVERSAL MEASURER;

Containing Tables of Measures, Weights, and Powers, for the use of Engineers, &c. &c. with an Appendix on the Strength of Beams, &c. and a correct method of calculating the Horse Powers of a Steam Engine.—Cullingworth, Leeds; and M'Phun, Glasgow.

THESE tables are of very general use, but especially to the working mechanic. They will enable him to ascertain, without calculation, the weight of his materials, or the power necessary to produce the work required. They will enable the labourer to ascertain the extent of the land he has cultivated; and artificers, of every description, will find them a ready reckoner in many calculations connected with their various occupations. For want of having such calculations at hand, it has often happened that mechanics and others have made hasty and incorrect estimates, which have occasioned loss both in property and reputation. These tables will therefore be useful in this point of view, and will serve as a check upon the calculations even of those who are expert in them, as they will both prevent the possibility of error and save the time consumed in repeating the operations. The first sixteen pages are occupied with the explanation of the tables, in which the manner of using them is shown, and applied to a variety of examples. The first and second tables contains calculations relating to the Steam Engine. We extract the first, as an example of the useful tables contained in the work:—

STEAM ENGINE.—The first column is the number of horse power; second is the

diameter of the cylinder; third is the area of the cylinder; fourth is the pressure of steam in pounds; fifth is the depth of water in yards and parts; sixth is the weight of water contained in a pump 12 inches diameter, at the depth mentioned in the fifth column; seventh is the number of ale gallons contained in the pump at the depth of fifth column; eighth is the cubic feet of steam consumed in a minute; ninth is the quantity of water in ale gallons raised in a minute. The piston of the engine is supposed to move through the space of 220 feet per minute.

Horse Power.	Diameter of Cylinder in Inches and Parts.	Area of Cylinder in Inches and Parts.	Pressure of Steam.	Depth of Water in Yards.	Weight of Water in Pounds.	Ale Gallons.	Cubic Feet of Steam in Feet and Parts.	Ale Gallons of Water per Minute.
	In. Pts.	In. Pts.	Lbs.					
1	5,4	22,8	228	1,54	228	22,25	19,2	576
2	7,6	45,4	454	3,07	454	44,25	38	576
3	9,25	67	680	4,6	680	66,4	56	576
4	10,75	91	910	6,15	910	88,8	73	576
5	12,0	113	1130	7,70	1130	111	94	576
6	13,1	134	1340	9,25	1340	134	112	576
7	14,2	159	1590	10,8	1590	156	130	576
8	15,2	181	1810	12,3	1810	177	147	576
9	16,1	203	2030	13,9	2030	200	168	576
10	17	226	2260	15,3	2260	222	350	1060
11	17,75	247	2470	16,9	2470	244	380	1060
12	18,5	268	2680	18,4	2680	266	414	1060
13	19,4	295	2950	20	2950	288	460	1060
14	20	314	3140	21,5	3140	310	488	1060
15	20,75	336	3360	23	4360	332	522	1060
16	21,5	362	3620	24,5	3620	353	559	1060
17	22,1	382	3820	26,2	3820	378	588	1060
18	22,75	406	4060	27,7	4060	400	629	1060
19	23,5	433	4330	29,3	4330	424	670	1060
20	24	451	4510	30,7	4510	446	700	1060
21	24,5	470	4700	32,3	4700	468	730	1060
22	25,2	498	4980	33,8	4980	489	770	1060
23	25,75	520	5200	35,3	5200	512	805	1060
24	26,25	542	5420	36,8	5420	532	835	1060
25	26,75	562	5620	38,4	5620	555	868	1060

The next table on the steam engine contains the diameter of the steam and eduction valves, their areas, and their openings; the diameter and areas of the cold water and air pumps; the number of ale gallons of condensing water used per minute, the weight of water used per minute, &c. The third table relates to the common lifting pump, its depth of water, diameter, length, and number of strokes per minute, quantity of water in ale and wine gallons, in cubic feet and in weight, per minute. The next six tables relate to the properties of the mechanical powers, the lever, the wheel and axle, the pulley, the inclined plane, the wedge and the screw. The next three tables relate to circles and circular measures, their diameter, areas, and circumferences, liquid and dimensionary contents, &c. *The succeeding tables relate* to the weights of stones, circular and square, to solid measure one yard deep, to malt guaging, cast iron, wrought iron, brass and leaden pipes and cylinders, globes, pillars, bars, &c., to glaziers' work, to vibrations of pendulums and falling bodies, to board measure, sheet iron and lead, to bricklayers' work, to land and superficial measure, and to the weight of coals contained in a given number of yards. There are also given, tables of decimal fractions, of brick measure, of mill work, of divisors for the sliding rule, of flat measure for glaziers, architects, &c. To these tables is added an appendix, on the force and heat of steam, on the power of steam engines and the method of computing it, and on the strength of materials.—We shall give some extracts from it in our next.

GLASGOW MECHANICS' INSTITUTION.

AGREEABLY to the resolution of the Members, founded on the official report of the proceedings of the Committee, given in No. XXVII. the five candidates for the lectureship on Chemistry and Mechanics in this Institution, delivered each a specimen lecture in rotation last week; and on Saturday the Members elected, by ballot, Mr. Thomas Longstaff, Lecturer, by a majority of fifty-two. Each of the unsuccessful candidates was, by the liberality of the members, voted the sum of £5 5s. instead of £3 3s. as formerly mentioned. The gentleman who has been elected, will, we have no doubt from the specimen he gave of his abilities, prove a great acquisition to the Institution. We are called upon, however, by some circumstances which have transpired, to reprobate the conduct of some individuals connected with the Institution. A very respectable candidate, belonging to this city, whose testimonials were of the highest scientific authority, and were borne out by the able and original lecture which he delivered before the members, was materially injured, in their estimation, by some calumnious reports, which, to our *certain knowledge*, were wholly unfounded. These reports, which had a reference both to his conduct and abilities as a candidate, were industriously circulated among the members, and had, we believe, a very great influence on the minds of many in determining for whom they should vote. The originators and propagators of these false and calumnious reports, will have the satisfaction of having injured, and perhaps prevented, the election of an individual who would have been an honour to the Institution; but let them not rest secure in their success, as they may be assured, that, if their names are not known, they are at least *strongly suspected*, and the whole odium of the reports will of course lie upon their own heads, and their conduct will, in future, be justly appreciated by the impartial members of the Institution to which they belong.—R. W.

Mr. Thos. Clark, Bath-Street, Glasgow, has handsomely given a donation of £5 5s. to the Institution, to buy apparatus.

RELIC OF BURNS.

As every thing relative to the patriotic bard of our country must be interesting to our readers, we cannot refuse ourselves the pleasure of being the first to notice one of the many relics that remain of his pleasing but wayward genius. The original of the following stanza, with the accompanying description, elegantly framed, may be seen at Messrs. Robertson & Atkinson's, Booksellers, 156, Trongate:—

"Hers are the willing chains of love,
"By conquering Beauty's sovereign law,
"But still my Chloris' dearest charm—
"She says she lo'es me best of a'."

"The above manuscript, from the hand of the immortal Burns, written on a pane of glass in one of the windows of the Globe Inn, Dumfries, is presented by John Thomson, Writer in Lockerbie, to Mr. John Speirs, Glasgow, in token of his friendship and regard.—15th September, 1824."

NOTICES TO CORRESPONDENTS.

Rusticus, G. S. Edinburgh, and Mr. Walter Ballantyne's (Water of Leith,) Force Engine, will be inserted next week.—Other Correspondents will please excuse us for a week.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written. Original Patents, Inventions, &c. will be inserted on the shortest notice.

Published every Saturday, by W. R. M'PHUN, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of STEUART & PANTON, Cheapside, London; and EDWARD WEST & Co. Edinburgh.

J CURLL, PRINTER.

[redacted]

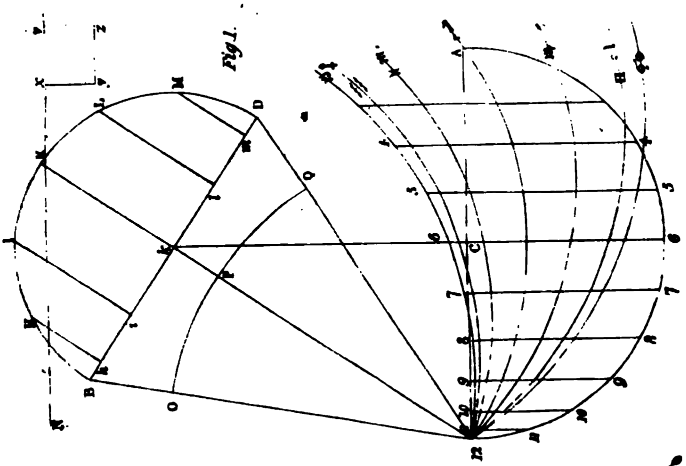
THE GLASGOW MECHANICS' MAGAZINE.

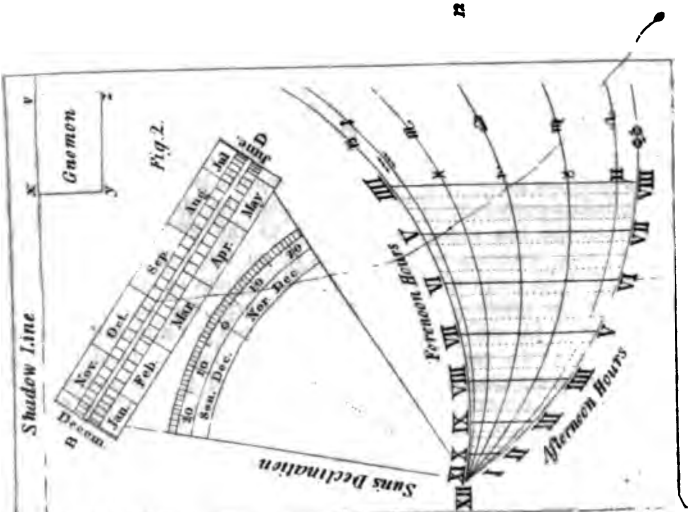
" Should not each dial strike us as we pass,
Portentous, as the written wall; which struck,
O'er midnight bowls, the proud Assyrian pale,
Ere while high-flush'd with insolence and wine;
Like that the dial speaks, and points to thee,
Loth as thou art to break the banquet up;
' O Man! thy kingdom is departing from thee,
And while it lasts, is emptier than my shade.'
Its silent language such; nor need'st thou call
Thy Magi to decipher what it means."

No. XL. *Saturday, 2d October*, 1824. Price 3*d*.

THE CAPUCHIN, OR PORTABLE CARD-DIAL,

Constructed for the LATITUDE *of* GLASGOW.





H. Wilson

THE CAPUCHIN, OR PORTABLE CARD-DIAL,

Constructed for the Latitude of Glasgow.

This curious and ingenious dial is said to have been originally invented by a Jesuit, and was constructed on the principle of a universal rectilineal dial. It was denominated the Capuchin, because it resembles the head of a Capuchin Friar, with an inverted cowl. We have thought proper to present it to the notice of our readers, as an amusing and useful instrument, which they can easily make for themselves, and as a part of the great body of science, which we consider both necessary and proper to lay before them.

Fig. 1, shows the geometrical construction of the dial, and is executed in the following manner:—About two-thirds from the top of the card, draw the line 12 C A, parallel to the top, and another line *k* C 6, bisecting it at right angles. With centre C, and distance C 12, or C A, describe the semicircle 12, 6, A, and divide it into 12 equal parts at the points, 11, 10, 9, 8, 7, &c. From these points draw the lines, 11, 11; 10, 10; 9, 9; &c. perpendicular to the diameter, 12 A, and they will be the hour lines. The half hour and quarter hour lines may also be drawn, by dividing each arc into two, and then into four equal parts. From 12, draw 12 *k*, making the angle C 12 *k* equal to the latitude of the place, (which, in the plate, is Glasgow, in lat. 55^{0} $56' 10''$ N.); let this line meet the 6 hour line in *k*, through which draw the line B *k* D, perpendicular to 12 *k*. From the point *k*, draw the lines 12 B, 12 D, making the angles *k* 12 B, *k* 12 D, each equal to $23\frac{1}{2}^{0}$, the sun's greatest declination. These lines determine the length of B D, which is the scale for the months. On B D, describe the semicircle, B K D, and divide it into six equal parts at H, I, K, L, M, and draw the lines H *h*, I *i*, K *k*, L *l*, M *m*, perpendicular to B D. These points are the centres of the arches for the signs of the zodiac.

With centres B and D, and distances B 12 and D 12, describe the arches 12 and Capricorn, and 12 and Cancer, to denote the two tropics. With centres *h* and *m*, describe arches passing through 12, and the one will be the arch of the signs Aquarius and Sagittarius, and the other, the arch of the signs Gemini and Leo. With centres *i* and *l*, describe arches passing through 12, and the one will be the arch of the signs Pisces and Scorpio, and the other the arch of the signs Virgo and Taurus. With centre *k*, describe an arc passing through 12, for the signs Aries and Libra. With centre 12, describe the arch O, P, Q, terminated in O and Q, in the lines 12 B, and 12 D; and divide P O and P Q, each into $23\frac{1}{2}$ equal parts; then the arc O P Q, is a scale of the sun's declination.

Find the sun's declination for every fifth day in the year from a table, and placing a ruler over the point 12, and the degree for each day on the scale O, P, Q, mark the point where the ruler meets B D; and at the points of division for the days of each month, write the name of that month, (see Fig. 2,) but observe that the days from 21st of March to the 23d of September, must lie on the left of *k*, which is the middle point of the scale. Cut a slit through the card along the line B D, and put a thread through the slit, having a bead sliding alongst it, and a plummet at one end, which hang along the face of the dial when held vertically; and make a knot on the other end of the thread, at the back of the dial, so that it may not be drawn through the slit. Draw a line N *v* parallel

to 12 C A, and at one end of it, cut slits along $v\,x$, $x\,y$, and $y\,z$, three sides of a rectangle, through the card, so as to admit of its turning about the remaining side, $v\,z$, as a hinge. This rectangle is the gnomon of the dial, and the line v N is the shadow line.

The method of placing the hours conveniently upon the hour lines, and of forming the scale of months, will be easily understood by inspecting fig. 2, which exhibits the dial completed.

To rectify the dial, set the thread in the slit right against the day of the month, and stretch it over the angular point, where the circles meet at XII, then shift the bead to that point of the thread, and the dial is rectified.

To find the hour of the day, raise the gnomon, (either more or less,) and hold the edge of the dial next to the gnomon, towards the sun, so that the uppermost edge of the shadow of the gnomon may just cover the shadow line; and the bead then moving freely on the face of the dial by the weight of the plummet, will show the time of the day among the hour lines, according as it is forenoon or afternoon. It may be observed, that the dial will indicate the hour but imperfectly, when it is near noon; but this defect cannot be properly avoided in an altitude dial.

To find the time of sunrise, and sunset. Rectify the dial for the given day, move the thread among the hour lines, until it either covers some one of them, or lies parallel between any two, and then it will cut the time of sunrise, among the forenoon hours, or the time of sunset among the afternoon hours.

To find the sun's declination, stretch the thread from the day of the month over the angular point at XII, and it will indicate the declination on the graduated arch.

To find on what days the sun enters the signs. When the bead, as above rectified, moves along any of the curve lines, which have the signs of the zodiac marked upon them, the sun enters those signs on the days pointed out by the thread in the scale of months. T.

SKETCH OF THE HISTORY OF PHILOSOPHY,

Particularly with reference to Mathematical and Mechanical Science.

(Continued from page 152, Vol. II.)

EMPEDOCLES, an eminent successor of Pythagoras, was born at Agrigentum, in Sicily. He made an important step in mechanical science, by introducing the action of two opposite principles in matter, which he termed *friendship* and *enmity*, very similar to the forces of attraction and repulsion, which occupy such a prominent place in the philosophy of modern times. Xenophanes, who followed, transplanted most of the opinions of the Pythagoreans into the small school which he founded at the town of Elea, in Campania in Italy. He had the merit of being the first to state the important principle in Geology—that the exterior crust of our globe was once in a fluid state, and that the fossil shells, and other marine productions discovered in the bowels of the earth and on the tops of the highest mountains, had at some remote period been formed under the waters of the ocean.

About this time, Hippocrates of Chios attempted the quadrature of the circle—a problem which has exercised the ingenuity of mathematicians in all ages. Fruitless as the attempt has ever been, to find a square exactly equal to the circle, or, which is the same thing, to find

the exact length of its circumference, yet the inquiries which have been instituted in its pursuit, have been the parent of many a brilliant and useful discovery. Many a time has the mechanic, since that period, after the labours of the day, endeavoured to discover, by mechanical contrivances, the rectification of the circle, and as often has he been disappointed. A knowledge of geometry, as delivered to us by the ancients, and as improved by the moderns, properly acquired, would prevent in future the vain attempt to discover what can be demonstrated, from the nature of the thing, to be impossible. The quadrature of the lunes was all that resulted from the attempts of Hippocrates, if we except Elements of Geometry, which he is said to have composed, but which have not reached our days.

Democritus, who flourished during the Pelopponesian war, may be considered as one of the greatest geniuses that Greece, so rich and varied in talent, had as yet produced. To procure the higher degrees of knowledge, he visited Egypt, conversed with the Magi of Babylon, and is said to have travelled eastward as far as the Ganges. The expense of these travels consumed his patrimony; and, on his return, he was content to occupy a small villa near Abdera, his native place, where he passed a long life of parsimony and seclusion, wholly intent on making experiments, and investigating the operations of nature. He rectified many of the prevailing errors in Natural Philosophy, and anticipated many of our modern discoveries. He maintained that the weight of bodies is always proportional to the mass, or quantity of matter, and that, consequently, they would fall in a vacuum, with equal celerities; he likewise entertained correct general views concerning the properties of light and heat. These tenets are unfolded in the beautiful poem of Lucretius on the Nature of Things, who applies to his master in philosophy the strong expression, "The father and inventor of all."

Philosophical sects had multiplied over Greece, when Socrates arose to give a more useful direction to the human mind. Disgusted with the absurd sophisms and delusive dreams of pretenders to science, he justly thought the first step to real knowledge was to perceive the extent of our ignorance. His great aim was not so much the laborious education of a few individuals, as the diffusion of solid instruction among the whole body of the people, an idea, which, it seems, required the lapse of more than 20 centuries to put in operation. Averse to idle speculation, he recommended that philosophy alone which is grounded on facts and experiments. He was accustomed to pour contempt on every kind of hypocrisy and pretension. But his intrepid conduct and high celebrity created a host of secret enemies, and the venerable sage at last fell a martyr to the cause of truth and virtue.

Plato, the most illustrious of all the disciples of Socrates, withdrew from the polluted city, Athens, after the murder of his revered master, and visited the seat of the Pythagoreans at Tarentum, where he was initiated in all the secrets of the Italic School. He next studied under Theodorus, an eminent mathematician of Cyrene, in Lybia. With a mind thus prepared, he travelled in disguise over the whole of Egypt, carefully examining every object, and gleaning all the information he could reach. Being prevented by war from proceeding farther, he returned home, and purchased the Grove of Academus, in the immediate vicinity of Athens; in which sequestrated

spot, he delivered, under the shade of spreading planes, his eloquent and impressive lessons, to youths of the highest ranks, who flocked from all parts, attracted by the fame of his genius.

The philosophy of Plato was deeply imbued with the mysticism of the Italic School. To him, however, we are indebted for the beautiful method of Geometrical Analysis, which furnished such a powerful instrument to direct the process of mathematical investigation. This invention, in the hands of his successors in the Academy, was continually extending the boundaries of science. It led immediately to the discovery of the conic sections, which, though cultivated for ages merely as a fine speculation, suggested at last to Galileo the laws of motions, and aided Kepler in his search after the true orbits of the planets. Plato had such a predilection for the Mathematical Sciences, that he caused the following inscription to be placed in large letters over the door of his Academy,—"Let no one enter here, who is ignorant of Geometry." To him we owe also the first treatise on the five regular bodies, commonly called the Platonic bodies; viz. the tetraedron, or solid, bounded by four triangular planes; the hexaedron, or cube: the octoedron, bounded by eight triangular planes; the dodecaedron, bounded by twelve pentagonal planes; and the icosaedron, bounded by twenty triangular planes. Besides these, there can be no other regular bodies in nature.

The properties of conic sections were at this time investigated in the Lyceum, and several of them were known to Aristeus, Menechmus, Dinostratus, and other Platonic geometricians. There was soon occasion to apply that knowledge to the duplication of the cube, a problem famous in antiquity, of the origin of which we have the following account from an ancient author.

While the plague ravaged Attica, deputies were sent to Delos, to consult the oracle on the means of appeasing the wrath of Heaven. The answer returned by the god was, that, to make the plague cease, they must double the altar of Apollo. That altar was of gold, and in a cubical form. The thing appeared easy to those who ignorantly undertook to solve the problem; and who, by doubling the sides, constructed an altar, not double, but octuple. Meanwhile the plague continued to rage, after the god absolutely required an altar exactly double. A new deputation was sent to him, and was answered, that the thing required was not performed. It was then suspected, that this duplication was a mysterious thing; and assistance was sought from the most famous geometricians, who were themselves much puzzled with it. This story appears to have been a fable contrived by some mathematician, who wished to give importance to the problem of two mean proportionals; by finding which, Hippocrates of Chio doubled the cube.

Whatever was the origin of this problem of the duplication of the cube, Plato gave a commodious, practical solution of it. Menechmus proposed two learned solutions of it, which deserve praise, as being the first known application of the geometric *loci*, and of the conic sections. It is probable, that the trisection of an angle also exercised the industry of the Platonic geometricians. Being a problem of the same order with that of the duplication of the cube, it requires like it, other resources than those of plane geometry. The ancients discovered several solutions of it, some of them remarkable for their elegance and simplicity.

Aristotle, whose authority so long maintained a despotic sway over the learned world, was born at Stagira, on the confines of Thrace and Macedon, 385 years before the Christian era. He studied 20 years under Plato, on whose death he retired to Mysia and Mytilene, till he was summoned by Philip, King of Macedon, to superintend the education of Alexander, afterwards surnamed The Great. When Alexander marched against Persia, his preceptor returned to Athens, and opened the Peripatetic School at the Lyceum. Aristotle continued to hold a regular correspondence with the Macedonian hero, who gave him the most liberal encouragement in the prosecution of his great work on the history of animals. He, however, remained only twelve years longer at Athens; and fearing persecution on account of his opinions, he retired to Chalcis, where he spent the last two years of his life. If we may believe what historians say of this celebrated philosopher, he was the author of 4000 volumes, of which now scarcely 20 are extant. Aristotle has been accused of depreciating the merit of his immortal master Plato; this, however, like many other traditions of the ancients, is not to be implicitly relied on; and, indeed, we have equal authority for the contrary assertion, as we are told that he revered his master so much, that he erected altars, and a monument to his memory, on which the following distich, in Greek, was to be engraven:

"Where Plato's consecrated dust is laid,
His grateful Aristotle rears this pile;
Oh, let not wicked steps his shrine invade,
Nor praise of impious tongue his name defile."

The very numerous writings of Aristotle were suffered to rot in a damp cellar, for 100 years after his death, and seem never to have been much esteemed by the Greek and Roman authors. No philosopher, however, whether in ancient or modern times, took such a wide range of disquisition; and yet his universal genius was marked by soundness of judgment, precision of thought, and singular acuteness, bordering frequently upon subtlety. Being ambitious to maintain the character of an original thinker, he did not always attempt to ground his philosophy on the close observation of facts. Had he been less ambitious of originality, restrained more frequently the flights of his imagination, and bent his investigations to the circumstances of real life, and the actual constitution of the universe, his conclusions would have been most valuable; as, indeed, they always were, whenever he could obtain accurate information, on which to exercise his penetrating sagacity. The natural history of Aristotle must be considered a wonderful production for the time when it was composed. He was the founder of Comparative Anatomy; and it is allowed that the divisions he then introduced, are still the best that could be made. His Meteorology abounds with fine remarks and just conclusions; and even his Mechanics and Physics, as well as his works on the Heavens, contain, amidst much which appears to us now as idle and extravagant speculations, some interesting doctrines, which are not unworthy of a better day. He wrote works also on Mathematics and Music; but nothing has escaped the ravages of time, except a few fragments sufficient to show that he was a master in these sciences, as well as in many others. His Rhetorics and Poetics, are such master-pieces of their kind, that, in 2000 years, they have never been excelled, and the human race have hitherto implicitly bowed to their authority. As Pope finally expresses it,

"The mighty Stagirite first left the shore,
Spread all his sails, and durst the deep explore;

That bold Columbus of the realms of wit,
Whose first discovery's not exceeded yet.
Led by the light of the Maeonian star,
He steered securely and discovered far.
Poets a race long unconfin'd and free,
Still fond and proud of savage liberty,
Received his laws, and stood convinced 'twas fit,
Who conquered nature, should preside o'er wit."

So methodical are his other works, and so full of mathematical illustrations, that a system of mathematics were at one time compiled from them. His peculiar opinions, however, deserve notice, from their extraordinary influence in the history of Philosophy. It is to be regretted that Aristotle ever suffered his mind to be drawn aside by the love of subtlety, and the delight of forming theories, from the strict investigation of facts. If, as a learned writer has said, the Peripatetics had cultivated Geometry with the same ardour as the followers of Plato, they would infallibly have made great and successful progress in Natural Philosophy.

(To be continued.)

SOLUTIONS TO CURIOUS AND USEFUL QUESTIONS.

(See page 104, Vol. II.)

Distances.—*Question 5th.*

Let x be the time each had travelled when they met; then it is evident that $\frac{11}{x}$ is their united rate of travelling; now H.'s rate is $\frac{11}{x+2}$ and G.'s $\frac{11}{x+1}$; therefore, $\frac{11}{x} = \frac{11}{x+2} + \frac{11}{x+1}$, or $\frac{11}{x} = \frac{22x+33}{x^2+3x+2}$, or $11x^2 = 22$, and $x = \sqrt{2} = 1.4142 +$ hours, the time each had travelled when they met; therefore H. takes 3.4142 hours and G. 2.4142 hours; H. having travelled 4.556 miles, and G. 6.443 miles, which is the distance from Glasgow to where they met.

G. D.

Otherwise.

Let $x =$ the miles travelled by H. before meeting, and $y =$ the miles travelled by G. Then, $y : 2 :: x : \frac{2x}{y}$ time before meeting; $x : 1 :: y : \frac{y}{x}$ time before meeting; and $\frac{2x}{y} \times \frac{y}{x} = \frac{2xy}{yx} = 2 =$ square of the time before meeting. Hence $\sqrt{2} =$ time of meeting. Therefore $1 + \sqrt{2} =$ the time taken by G. in travelling; and $2 + \sqrt{2} =$ the time taken by H. in travelling. Again, $\frac{y}{x} = \sqrt{2}$, and $y = x\sqrt{2}$. Therefore $y : x : \sqrt{2} : 1$; hence the distances are as $\sqrt{2}$ to 1, or $x + y = x + x\sqrt{2} = 11$; whence $x = \frac{11}{\sqrt{2}+1} = 11 \times \sqrt{2} - 1 = 4{,}556$; and $y = 11 - 4.556 = 6.443$.—Rusticus.

Trees.—*Question 6th.*

The four trees may be placed at the same distance by planting one at the top of a hill, or bottom of a pit, in the shape of a tetraedron, and the other three at the angles of the base, or mouth.—M. A., G. D., Rusticus, J. F., and G. S. Edinburgh.

Apples.—*Question 7th.*

The puzzle respecting the apples may be solved, by supposing each of the daughters to have sold them at the rate of five for a penny, at the beginning of the market; but their rare quality increasing the demand, has induced the fair sellers

to demand a penny for each; previous to which, the first would have sold fifteen, the second ten, and the third five—leaving one, two, and three apples, respectively, to dispose of at one penny each. Their account of sales will therefore stand thus:—

$$\left(\frac{16-1}{5} \times 1\right) + \left(1 \times 1\right) = 4$$

$$\left(\frac{12-2}{5} \times 1\right) + \left(2 \times 1\right) = 4$$

$$\left(\frac{8-3}{5} \times 1\right) + \left(3 \times 1\right) = 4$$

Therefore, each of the fair ladies will bring home fourpence.—G. S.

This question admits of different answers:—it was also solved by Rusticus.

WHEELS.—*Question 8th.*

As the large wheel has 576 teeth, $\frac{576}{360}, \frac{576}{234}, \frac{576}{168}, \frac{576}{128}$, will, respectively, represent the number of revolutions of the small wheels during one of the larger. By reducing these fractions to their lowest terms, and multiplying their denominations continually into one another, it will give the least number of revolutions performed by the great wheel; and this number multiplied by the said fraction, will point out the number of revolutions performed by each of the small wheels, before the chalked teeth come into contact. Thus:— $\frac{576}{360}, \frac{576}{234}, \frac{576}{168}, \frac{576}{128}, = \frac{8}{5}, \frac{32}{13}, \frac{24}{7}, \frac{9}{2}$, — hence $5 \times 13 \times 8 \times 2 =$ 910, number of revolutions of the great wheel, and $910 \times \frac{8}{5}$, $910 \times \frac{32}{13}$, $910 \times \frac{24}{7}$, $910 \times \frac{9}{8}$, = 1456, 2240, 3120, 4095, number of revolutions of the small wheels.—G. S.

Otherwise.

The usual method taught by Arithmeticians to find a common measure, *i. e.* to find the lowest number that can be divided by the number of teeth in the wheels A, B, C, D, and E, will answer the question; this will be found to be 524160, which divided by 576, 360, 234, 168, 128, respectively, will give the following revolutions of each wheel, when they will be in the same situation they were in when the teeth were chalked, *viz:* A 910; B 1456; C 2240; D 3120; E 4095; revolutions.

G. D. Master R. N.

[This question was also solved by Rusticus.]

SCALES.—*Question 9th.*

Let x = the root of the scale required. Then $(2 \times x \times x) + 4x + 3 = 649$ per question; that is, $2x^2 + 4x + 3 = 649$, or $x^2 + 2x = 323$; hence, by completing the square and resolving the equation, $x = 17$. Therefore the scale is the decimo-septenary.

G. S.

[Solved also by Rusticus.]

NEW MULTIPLICATION TABLE.

SIR,—Arithmetic, or the science of numbers and their various combinations, is one of the most wonderful, and, at the same time, one of the most useful inventions of human genius; its elementary rules are few and simple; and, among these, Multiplication holds the most conspicuous place. Any attempt, therefore, to simplify the mode of conveying the knowledge and practice of this rule to youth, will, I hope, not be unacceptable to the readers of your very useful Miscellany.

When children are set by their teach-

ers to learn arithmetic, after being instructed in the rules of addition and subtraction, the *multiplication table* presents a formidable obstacle to their further progress; and this must be overcome by dint of close application to the dry committal to memory of the several products of the digits, in the way of question and answer. Some children of quick memories soon get over this, but others find it a very laborious and irksome task. Unless, however, the impression is kept up and established by continued practice, it is very apt to be forgotten; and even after it is learned, they are obliged, in all their after progress, to depend on the readiness and accuracy of their memories for their surety in calculation.

In after life, when we are about to put down the product of any two numbers, such as that of 6 and 9, we say mentally, *six times nine is fifty-four;* and this result we arrive at solely from the recollection of the answer to the question, *what is six times nine?* which we used to give at school. Now, if we compare this mental process, with what we every hour experience in reading, we find a striking difference in the facility of the two processes.

Thus, whatever combination of letters are presented to the eye in the form of words, we at a glance pronounce the words, without the mental circumlocution (if I may so express it) of enumerating the letters of which the words are composed. When we see the letters *t w o* placed together, we instinctively read the word *two,* and as invariably associate the idea of that number with the appearance of the three letters. In like manner, when two digits are presented to the eye, as 5 7, or 7 5, we at once read fifty-seven or seventy-five, without any exercise of memory.

Now, Sir, it has often occurred to me, that *the product* of two figures might be seen and read at a glance in the same way, if we were early trained to it. May not a 5 and a 7, when placed the one below the other, as $\begin{matrix}7\\5\end{matrix}$ or $\begin{matrix}5\\7\end{matrix}$, be at once read *thirty-five,* with as much facility as fifty-seven or seventy-five, when placed laterally. It may be said, indeed, that in numeration the names of the digits naturally suggest the number, but not the product. This must be admitted; but any objection arising from this circumstance will vanish in a moment, when we consider that in reading, the alphabetical characters employed bear no analogy whatever to the ideas suggested to the mind by their combination.

The letters *a t r,* or the sounds given to them, have no connection with the ideas of science, the quadruped, or the article of commerce, expressed by their different combinations in *art, rat,* and *tar.* And yet, by early habit and the principle of association, these characters so presented to us, invariably suggest the things they are designed to represent; and this habit, once gained, is never afterwards lost. This principle may be farther illustrated, by reference to the facility and certainty with which children learn to read and comprehend the numbers expressed by the Roman numerical letters, used in our version of the Bible and Psalms, to note the chapters. Thus: XVI, from habit, instantaneously suggests the number *sixteen;* and the same three letters, differently placed, thus, XIV, suggest *fourteen.* Now, I think it will be readily admitted, that if the digits were placed together in the manner in which they usually meet the eye in the process of multiplication,

Thus,						
3	8	7	8	6	7	8
6	7	9	3	7	7	8
XVIII	LVI	LXIII	XXIV	XLII	XLIX	LXIV

that the figures so placed may be taught by habit, to represent the corresponding products instinctively; which would be a much simpler effort than that employed to suggest the same numbers by these combinations of Roman characters.

I would therefore beg leave to propose a multiplication table, constructed on the above principle, which children might simply be instructed to read at this stage of their arithmetical education, in preference to their *learning by heart* the present table in use. This, I conceive, would prove a great advantage both to teachers and their pupils, in simplifying the most essential and fundamental part of arithmetic. I merely subjoin a sketch of the scheme, which may be modified and improved by the superior knowledge and experience of teachers.

FIRST PART.

Products.	Products.
$\left.\begin{matrix}2\\2\end{matrix}\right\}$ Four.	$\left.\begin{matrix}2\\9\end{matrix}\text{ or }\begin{matrix}3\\6\end{matrix}\right\}$ Eighteen.
$\left.\begin{matrix}2\\3\end{matrix}\right\}$ Six.	$\left.\begin{matrix}4\\5\end{matrix}\text{ or }\begin{matrix}2\\10\end{matrix}\right\}$ Twenty.
$\left.\begin{matrix}2\\4\end{matrix}\right\}$ Eight.	$\left.\begin{matrix}3\\7\end{matrix}\right\}$ Twenty-one.
$\left.\begin{matrix}3\\3\end{matrix}\right\}$ Nine.	$\left.\begin{matrix}2\\11\end{matrix}\right\}$ Twenty-two.
$\left.\begin{matrix}2\\5\end{matrix}\right\}$ Ten.	$\left.\begin{matrix}4\\6\end{matrix}\text{ or }\begin{matrix}2\\12\end{matrix}\right\}$ Twenty-four.
$\left.\begin{matrix}2\\6\end{matrix}\text{ or }\begin{matrix}3\\4\end{matrix}\right\}$ Twelve.	$\left.\begin{matrix}5\\5\end{matrix}\right\}$ Twenty-five.
$\left.\begin{matrix}2\\7\end{matrix}\right\}$ Fourteen.	$\left.\begin{matrix}3\\9\end{matrix}\right\}$ Twenty-seven.
$\left.\begin{matrix}3\\5\end{matrix}\right\}$ Fifteen.	$\left.\begin{matrix}4\\7\end{matrix}\right\}$ Twenty-eight.
$\left.\begin{matrix}2\\8\end{matrix}\text{ or }\begin{matrix}4\\4\end{matrix}\right\}$ Sixteen.	$\left.\begin{matrix}5\\6\end{matrix}\text{ or }\begin{matrix}3\\10\end{matrix}\right\}$ Thirty.

And so on.

SECOND PART.

To be on a Separate Card.

5	6	3	8	9	12	4
9	4	7	4	3	6	11
3	4	6	4	11	9	7
2	5	3	7	2	8	12
4	3	5	6	7	11	2
4	9	7	6	7	4	7
6	7	7	8	9	12	3
9	8	5	5	7	5	5
7	11	12	11	3	5	12
10	10	9	11	3	5	12

And so on through all the combinations, amounting to seventy-seven in all; to be read by pronouncing the products in the same manner as a lesson in reading.

When it is considered, that there are only seventy-seven different combinations of the figures, from 2 to 12, upon which the whole process of multiplication depends; it follows, that children may, with as much facility, learn to pronounce *the products* by a glance at *the figures* which produce them, as to read or pronounce the same number of monosyllables, by a glance at the *letters* which compose *them*.

I am, Sir, your's, &c.

G. B.

Hamilton, 20th Sept. 1824.

P. S.—I may add, that the above is not a mere theory or speculation, as, in the course of my business, I have found considerable benefit by its adoption for some time past.

[Though we are not so sanguine of the practicability of our ingenious Correspondent's scheme as he seems to be, yet we have inserted it, as it may perhaps lead others to invent something by which the labour of learning the multiplication table may be diminished, which is well known to be a very great desideratum.]

VARIOUS COMMUNICATIONS.

NEW CLASS for MECHANICS.

Sir,—Through the kindness of a friend, I obtained admission, on Monday night last, to the Mechanics' Class in this City, and was inexpressibly delighted to see so many young men collected together, after the labours of the day, and listening, with great attention and pleasure, to a Lecture upon Natural Philosophy and Chemistry. If, thought I, any thing be a proof of the growing improvement of my countrymen, not only in knowledge but also in morals, this Institution is one. Upwards of eight hundred men, whose bodily energies might be supposed exhausted by the toils of the day, assembled for the purpose of forming an acquaintance with the discoveries of a Newton and a Davy! Impressed with

what I saw, I could not but anticipate the time as not far distant, when the distinctions of vulgar and refined, of learned and illiterate, should be shown to have no real foundation; and when the lowest of the people should be able to throw off those prejudices which, from the beginning of society, have less or more shut them out from the pleasures of the understanding, and made them the dupes of designing men.

Under the influence of this train of reflection, I addressed myself to a man sitting by me, who was evidently a common mechanic, with nothing to recommend him to particular attention. I had not, however, long conversed with him, till I discovered that his stock of information, especially upon the subjects on which we were in expectation of immediately hearing a Lecture, was highly respectable. At this time the Class, I was told, were hearing Candidates for the Lectureship, and my neighbour expressed himself very sensibly on the requisites for such a situation. In the course of our conversation, I was occasionally amused with the man's uncouthness of pronunciation, as well as with the terms which he sometimes employed. When a philosophical term was uttered, it generally suffered a most terrible transformation; and, as my mechanical friend was rather partial to words of this sort, he often fell into blunders in their application. What, however, struck me most, was his total ignorance of grammar. This ignorance manifested itself not only by the violation of the established rules of construction, but by the confused manner in which the different parts of his sentences were arranged. It therefore naturally occurred to me, that a Teacher of Grammar and Composition would be an important acquisition to the class of persons around me; and that, so soon as the candidates for the Philosophy Chair are heard, steps should be taken to procure such a Teacher. Your giving a place, in your Magazine, to this letter, may perhaps have the effect of awakening the attention of the Mechanics' Class to the utility of the measure which I have thus taken the liberty to suggest, whilst, at the same time, you will much oblige,

Sir,

Your obedt. servant,

F.

Glasgow, 16th Sept. 1824.

ON THE CRANE.

Sir,—One of your Correspondents, in a late No. of your Magazine, wishes to be informed whether the crane for raising weights was first used in this city at the suggestion of Dr. Birkbeck. I beg leave to state that, to my certain knowledge, it was in use here many years previous to the Dr.'s visit. Surely your Correspondent does not mean to hint that Dr. B. was the *inventor* of the crane. Every one knows that it is a very old invention—perhaps as old as the tower of Babel, or the pillars of Seth, as mentioned in one of your Nos.; at all events, if it was not then invented, it must have been very much wanted. I should have thought it unnecessary to reply to such a query, had it not appeared, by the mode of stating it, that the author wished to raise the Dr.'s fame by a mode which was not only absurd, but which it stands in no need of, as it rests upon a much more solid foundation. I have heard his lectures to mechanics in this town with the greatest interest; and can remember, that many things which he then treated of, appeared new and extraordinary to his hearers, which, now-a-days, are reckoned quite common and ordinary, from the increased knowledge and means of improvement afforded to mechanics, to which the Dr. contributed in no small degree. The consequence of this is, that they have been led to think and to study for themselves; and, like the noble Bereans of old, "to search daily whether those things were so." Hence many things which might formerly be considered as the invention of the individuals who first mentioned them, would be found to belong to men of former generations, and of more distant climes.—Can you, or any of your Correspondents, inform me, whether the late Professor Anderson did not anticipate or propose a class for the instruction of mechanics or artisans, or at least suggest something of the kind in his will?

A Mechanic.

Glasgow, 20th Sept. 1824.

ON A COMMON FIRE.

Mr. Editor,—Three questions are put in the second Number of your useful Miscellany, page 29, Vol. I. to which I have observed no answer.* A consider-

* Our Correspondent has not seen No. X. page 159, Vol. I.

ation of the following circumstances may be regarded as an answer to the first query, which is, " why doth the sun shining strongly upon a common fire put it out," or rather diminish its intensity, and make it burn more slowly, which is a juster statement of the question.

When a fire is first lighted, the first effect is a rarifaction of the surrounding air. This rarified air arranges itself into the form of a cone, which surmounts the fire and stands over it; and by its comparative lightness, it is perpetually ascending, until it is cooled and balanced by an upper stratum of air, with which it mixes. Hence, the balance of the air in the neighbourhood of the fire is destroyed and a motion created. The heat evolves fresh portions of gas from the fuel, for which the oxygen in the air has a strong affinity. The air, impelled by this affinity, rushes into the fire, and is there decomposed; its oxygen combines with the gas evolved from the fuel, forming different products, and the remainder of the air is rarified by the heat and ascends, still maintaining the rarified column above the fire. But as this column is specifically lighter than the surrounding air, it will make constant efforts to break in upon it, and these efforts will be most successful upon that part of the column, where the difference between it and the surrounding air is greatest, which is at the bottom of the column. These efforts are obvious, from the dashing about of the flame, which is still twinkling from side to side, as the surrounding air prevails upon the rarified cone.

This difference in the specific gravity of the cone and the surrounding air, is the cause of forcing a large current of air to pass through the fire, and of supplying it with a large portion of oxygen, to which the vigour and intensity of the fire always bears an exact proportion.

From these considerations, the solution of the question becomes easier. When the sun shines upon the fire, or near it, the air is thereby rarified, and the difference between it and the cone, which surrounds the fire, is lessened. Hence, the consumption of oxygen is diminished; the production of heat diminishes in the same proportion; the evolution of gas from the fuel is also lessened, and the fire languisheth.

Upon the same principle, a fire burns keener in a cold day, and in a cold room, than it doth in a warm day, and in a warm room. Not that the air is any heavier, or contains more oxygen in a cold than in a warm day; but the difference between its temperature and the temperature of the column is greater. An air furnace is a contrivance to shelter the surmounting column upon all sides from the air, and oblige it all to pass through the fire. A blast furnace is the air forced into a fire by a machine. In all cases of combustion, the air, or rather the oxygen contained in the air, is the agent. The heat of a fire is the excess of caloric above what is necessary to decompose the fuel.

How agreeable a thing it is to sit by a good fire in a cold day! While it warms our limbs, and enlivens our system, it lays before us a fund of instruction, in its accommodation to our convenience, and offers a source of rational enjoyment to our mental faculties. While we view the beautiful play of affinities, that shed their genial influences around us, not with the vacant gaze of a savage, but with the eye of science, which it seems to be the object of your Magazine to brighten and enlarge, and to excite a tribute of devotion to him to whom it is justly due.

Sir, your's, &c.

W. S.

Methven, September 4, 1824.

MENTAL CALCULATION.

A Correspondent suggests that the usual mode of calculating sums per annum, from sums per day, may not be universally known to our readers. On the near coincidence of the number of pence in a pound and a half, with the number of days in a year, the rule is founded. For, since there are 240 pence in a pound, if to this number we add its half, or 120, it becomes 360; a number which wants only five days of a year. Hence, a penny a-day, is a pound and a half and fivepence a-year; or £1 10s. 5d. per annum. And any number of pence per day, will be so many pounds, half pounds, and fivepences per annum.

Hence the rule, to find how much per annum, any sum per day will produce; *Reduce the sum to pence, if not so given, add a half of the pence to the whole pence, and this sum will be the number of pounds for 360 days; to which add the product of the pence by 5, the odd days, and the sum will be the amount per annum.* Example: A pensioner has 8d. a-day, how much is that per year? To 8d. add 4d. and the sum is £12; to which add 5 times 8d.

or 3s. 4d. and the amount is £12 3s. 4d. per year. Again: A labourer has 1s. 6d. per day, how much is that per year? First, 1s. 6d. is 18d. to which add 9d. and the sum is £27; to this add 5 times 18d. or 7s. 6d. and the amount is £27 7s. 6d. per annum.—H. M.

TO PROCURE LIGHT.

A Correspondent suggests that a light may be procured, in the winter mornings, most easily and speedily, by means of a small brass condenser, or cylinder and piston, commonly exhibited in Philosophical Classes to show the properties of condensed air in the instantaneous inflammation of combustibles. He thinks this would be a better mode of obtaining a light than by a tinder-box, phosphorus, &c. or by running about from shop to shop with large pieces of flaming paper, to the imminent danger of the lieges and of their own property.—D. A. N.

HEATING LARGE ROOMS.

Another Correspondent suggests that a stove is a better mode of heating large rooms than a fire; and he says, the usual objection, that the air of the room becomes frequently too hot and sickening, may be wholly removed by putting a small vessel, full of water, upon a convenient part of the stove; and that, by the evaporation of the water, the air in the room is rendered humid and agreeable, instead of dry and exhausting.—Z.

NEW INVENTION IN SILK-SHAWL MANUFACTURE.

Mr. Alexander Buchanan, weaver in Paisley, has invented a mode of manufacturing silk shawls of a "novel and beautiful texture," which has been so highly recommended by the manufacturers there, that the Board of Trustees in Edinburgh awarded him the sum of 20 guineas for his ingenuity. The testimonials, &c. in favour of the inventor may be seen at our office; they are from the following respectable gentlemen:—Jas. Buchanan, Elder, and John Geddes, Minister; Messrs. William Bissland & Co. Silk Manufacturers; Robert Farquharson, Manufacturer and Magistrate; James Carlisle, Provost; William Fulton & Sons, Silk Manufacturers, Paisley; and G. Thomson, Assistant Secretary to the Board of Trustees, Edinburgh. The process is hitherto kept secret.

ON PRESERVING BOOKS.

Sir,—Your Correspondent J. C. has given a very simple and efficacious remedy for extracting the marks of flies from paper, which I have adopted in the case of several books that were much injured in this way, and have found quite successful.

As some of your readers, however, may, like myself, have a more serious grievance to complain of with regard to their Libraries, *viz.* the attacks of worms and insects, which, at this season of the year, deposit their eggs in books, and especially in those leaves near their covers, I would suggest a plan by which they will be effectually preserved from their attacks.

From the eggs proceed a sort of mites, which are transformed into beetles, which eat their way through till they reach the extremity of the book. As they are attracted to books, not from any literary penchant, but merely on account of the paste used in their binding, if any mineral salt, such as *arcanum duplicatum*, *allum*, or *vitriol*, were mixed in its composition, books might set at defiance the attacks of all kinds of worms and insects, and book-collectors might be saved much annoyance and vexation.

I am, Sir, your's, &c.

D.

METHOD OF CURING INJURIES AND DEFECTS IN TREES.

Take one bushel of fresh cow-dung; half a bushel of lime rubbish from old buildings; (that from the ceilings of rooms is preferable;) half a bushel of wood-ashes; and a sixteenth part of a bushel of river sand. The three last articles are to be finely sifted before they are mixed; then work them well together with a spade, and afterwards with a wooden beater, until the stuff is very smooth, and like fine plaster used for the ceiling of rooms. The composition being thus made, care must be taken to prepare the tree properly for its application, by cutting away all the dead, decayed, and injured parts, till you come to the fresh sound wood, leaving the surface of the wood very smooth, and rounding off the edge of the bark with a draw-knife, or other instrument, perfectly smooth, which must be particularly attended to Then lay on the plaster, about one-eighth of an inch thick, all over the part where the wood, or bark, has been so cut

away; finishing off the edges as thin as possible: then take a quantity of dry powder of wood-ashes, mixed with a sixth part of the same quantity of burnt bones; put it into a tin-box, with holes in the top, and shake the powder on the surface of the plaster, till the whole is covered over with it—letting it remain for half an hour, to absorb the moisture; then apply more powder, rubbing it on gently with the hand, and repeating the application of the powder till the whole plaster becomes a dry smooth surface. All trees cut down near the ground should have the surface made quite smooth, rounding off in a small degree, as before mentioned; and the dry powder directed, to be used afterwards, should have an equal quantity of alabaster mixed with it, in order the better to resist the dripping of trees, and heavy rains. If any of the composition be left for a future occasion, it should be kept in a tub, or other vessel, and urine of any kind poured over it, so as to cover the surface; otherwise the atmosphere will greatly hurt the efficacy of the application. Where lime rubbish of old buildings cannot be easily got, take powdered chalk, or common lime, after having been slaked a month at least. As the growth of the tree will gradually affect the plaster, by raising up its edges next the bark, care should be taken, where that happens, to rub it over with the finger when occasion may require, (which is best done when moistened by rain,) that the plaster may be kept whole, to prevent the air and wet from penetrating the wound.—W. R.

21st September, 1824.

LIGHTING CHURCHES.

A Correspondent wishes to know whether it would be better to light a Church by one single large chandelier, or by several smaller ones?—L. C. K.

CAPITAL RAT-TRAP.

A Correspondent suggests the following ingenious mode of catching rats:—"Let a cask, ingeniously placed, be half filled with water, and let a false top, or lid, be nicely balanced about two inches below the edge of the mouth; in the middle of the lid let some wholesome meat be fastened, (as rats are very nice,) so that, the moment one of them sets foot upon the edge, it may be precipitated into the water below; and, as the lid immediately resumes its position, the victim is secured, and a second, a third, or a fourth, may be successively secured and destroyed, if they be not all drowned before the cask be inspected."—L. M'L.

QUERIES.

1st, In A. B.'s air-pump, described in No. XXXII. Vol. II. when the piston descends, after having discharged the air at the valve in the lid of the pump, does not the air in the inside of the receiver tend to force it back in descending, by pressing against the vacuum forming above the piston; and, if so, will it not be too heavy to work in making experiments?

2d, What is the best method of softening iron?

3d, How is the Chuck made for turning those beautiful intersected lines which we see on the back of the Bank Notes? If any of your Correspondents should answer these, they will much oblige many of your readers, and, among the rest—G. G. B.

Johnstone, 21st Sept. 1824.

[G. G. B.'s account and *drawing* of the method of "Turning Small Metal Rods parallel," &c. is not sufficiently distinct; he would oblige us by sending a more perfect copy of both.]

SCIENTIFIC INTELLIGENCE.

THE SCRAP-GATHERER.

No. 43.—*Useful Cement for Turners and Artizans in general.*—Sixteen parts of whitening are to be finely powdered and heated to redness, to drive off all the water; when cold, it is to be mixed with an equal quantity of black rosin, and one part of bees-wax; the latter having been previously melted together, and the whole stirred till of an uniform consistence.

44.—*Brass Lacker for Tin Ware.*—To one pint of rectified spirits of wine, put two ounces of seed-lac, two drachms of dragon's blood, and one ounce of turmeric powder; let the whole remain eighteen days, shaking it often, and then strain it through coarse muslin. With a brush put it on the article intended to be lackered.

45.—*Lacker for Brass Work.*—To a

pint of spirits of wine, put one ounce of turmeric powder, two drachms of best anatto, and two drachms of saffron; let it stand ten days, shaking the bottle often, and filter through coarse muslin into a clean bottle, then add three ounces of clean seed-lac, and shake the bottle often for fourteen days. The brass, if large, must be first warmed, so as to heat the hand, the varnish then to be applied with a brush. Observe: this varnish gives the brass rails of desks, &c. a beautiful appearance.

46.—*To make Artificial Sea Water.*—Take common sea-salt, two pounds; bitter purging salt, two ounces; magnesia earth, half an ounce; dissolve all in river water, six gallons. These are the exact proportions and contents of sea-water, from an accurate analization.

ROBERTS' MECHANICS' ASSISTANT, OR UNIVERSAL MEASURER, &c. &c.

(Continued from page 159, Vol. II.)

The FORCE *of* STEAM *and the* HEAT *of it.*—At the temperature of 212 degrees of Fahrenheit's thermometer, the force of steam from water is just equal to the pressure of the atmosphere; but, by increasing the heat, effects will be obtained which are detailed in the following Table:—

Steam predominating over the pressure of the atmosphere upon a safety-valve, if its elastic force be equal to	Pounds per square inch, requires to be maintained by a temperature equal to.....	Degrees of heat by Fahrenheit's thermometer; and at these respective degrees of heat, steam can expand itself to about.................	Times its volume, and yet continue equal in its elasticity to the pressure of the atmosphere.
5	227½	5	
6	230¼	6	
7	232¾	7	
8	235¼	8	
9	237½	9	
10	339½	10	
15	250½	15	
20	259½	20	
25	267	25	
30	273	30	
35	278	35	
40	282	40	

By small additions to the temperature, an expansive force may be given to steam so as to be equal to 400 times its natural bulk, or in any other proportion, provided the vessels, &c. that contain it be strong in proportion.

The Power of STEAM ENGINES, *and the Method of Computing it.*

In computing the power of a steam engine, *three* things must be duly observed:—1. The width or diameter of the piston or cylinder. 2. The length of the stroke. 3. The strength of the steam.—It is supposed that the piston does, or ought to travel 220 feet per minute.

The power of an engine must vary according to the strength of the steam; and this must be the first point to be decided. This pressure is fixed at different ratios by different makers, varying from 7 to 12 lbs. upon the square inch. At Soho, they commonly fix it at 7 lbs., and Smeaton only reckoned 7 lbs. upon every *circular* inch.

Now, the pressure being determined by the weight upon the safety-valve, here is the most correct of all methods of ascertaining the power.

First, Find out how many hogsheads or pounds of water the engine is capable of raising ONE foot high in ONE minute.

Secondly, Divide that amount by the supposed ratios or supposed power of a horse to raise water one foot high in one minute of time, and the quotient will give horse powers of the engine.

RULE.—1. Find the area of the piston in square inches, by squaring the diameter and multiplying the amount by .7854, and the product will be the correct area. Or, as the decimal .78 is

near to .75 or $\frac{3}{4}$; for a ready calculation not *exactly* correct, square the diameter and take $\frac{3}{4}$ of that sum, and that will be the area, nearly; or the diameter of the piston multiplied by its circumference, and that divided by 4 will give its area in square inches.—2. The area of the piston in square inches, must show the number of square inches exposed to the pressure of the steam; now, if we multiply this area by the pressure upon every square inch, we shall have the whole pressure upon the piston, or the weight which the engine is capable of raising; and if the piston travel 220 feet per minute, that amount, multiplied by 220, must give the weight of water that the engine is capable of lifting, 1 foot high in one minute.—3. Messrs. Boulton & Watt suppose a horse able to raise 32000 lbs. avoirdupoise, 1 foot high in a minute. Dr. Desaguliers makes it 27,500 lbs. Mr. Smeaton only 22,916. Divide the number of lbs. that an engine of one horse power can raise 1 foot high in 1 minute, and the quotient will give the horse powers.

Example.—What is the power of a steam engine, the cylinder of which is 24 inches, which makes 22 double strokes in a minute, each stroke being five feet long, and the force of the steam equal to 12 lbs. avoirdupois upon every square inch?

24 Inches.
24
———
96
48
———
576
,7854
———
452,3904 area, nearly 452,4 square inches.

452,4 square inches,
12 lbs. per square inch.
———
5428,8 the whole pressure upon the piston.

The engine makes 22 *double* strokes, each five feet in a minute = 220 feet, then

5428,8 lbs. multiplied by
220 feet travelled per minute.
———
1194336 lbs. raised one foot high in one minute.

This, divided by the standard of each Engineers' calculation for a horse's power, and the quotients will give of

Boulton and Watt's,..............................37 Horse Power.
Desagulier's,..............................43 do. do.
Smeaton's,..............................52 do. do.

NOTICES TO CORRESPONDENTS.

Walter Ballantyne's Fire Escape and Force Engine will be inserted in No. XLII.; in the meantime, the bird's-eye-view he promised, and a more distinct description would be acceptable. It would have been inserted this week, but was found not sufficiently distinct to be well understood.—A. Allison must be more scientific.—We would feel obliged if an 'Old Mechanic' would transmit the drawings he mentions, and also if he would cause some one to act as an amanuensis to him, as we really are extremely puzzled to make out his autography; in fact we cannot make out the meaning of his last communication at all.—In the solution of the 1st of the curious and useful questions, the mean proportional is taken geometrically by Rusticus, but arithmetically by G. S. It ought to be geometrical. Rusticus will favour us by completing his solution of this, and also of the 2d, which G. S. has solved but very operosely. We wish each to check the other, to save ourselves trouble. Why is the 3d question not solved at all by any of our Correspondents? G. D.'s other queries will be inserted at a future opportunity.—A. B., Dollar, in good time.—D. A. N. and L. M'L. are attended to.—Y. under consideration.—There was no room for the extract from Dr. Ure's Berthollet on Dyeing in this Number, but it will be given in the next.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement which is the subject of their notice.

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THE GLASGOW
MECHANICS' MAGAZINE.

" A wise man is strong."—*Solomon.*

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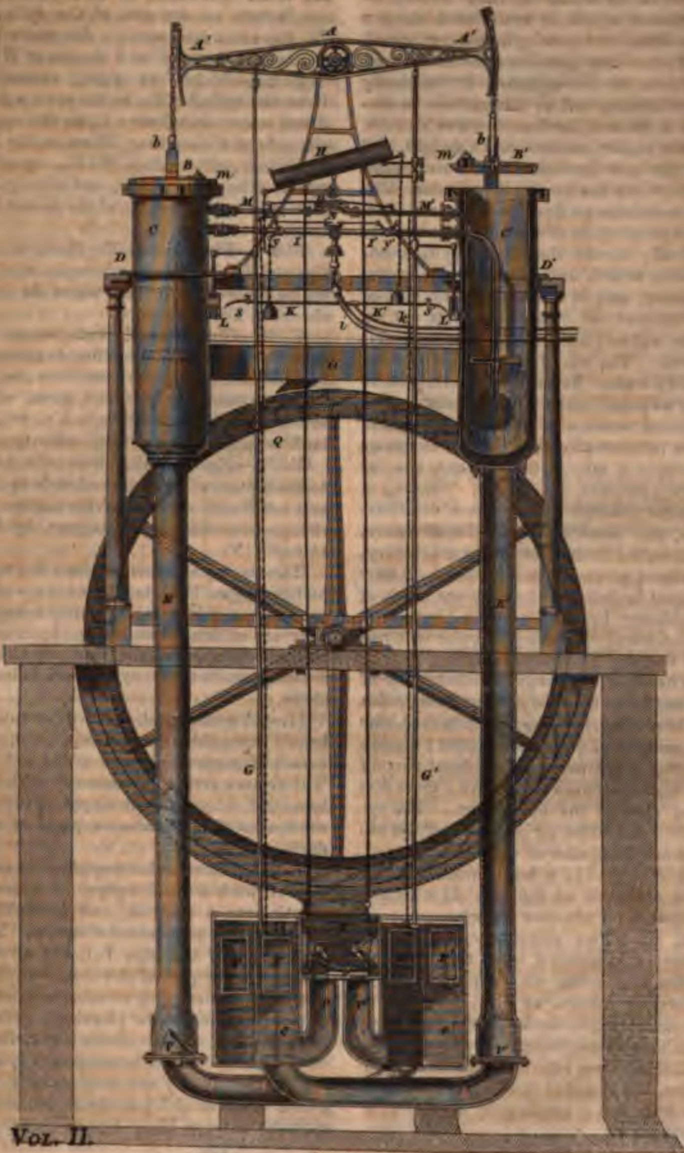
BROWN'S PNEUMATIC OR GAS-VACUUM ENGINE.



— Swan Sc —

A PNEUMATIC OR GAS-VACUUM ENGINE,

Invented by Mr. Brown, London.

In describing this invention, the patentee states in his specification, the objects he contemplates, in the following words: "My invention consisteth, first, of a combination which is thus formed:—Inflammable gas is introduced along a pipe into an open cylinder or vessel, whilst a flame placed on the outside of, but near to the cylinder, is constantly kept burning, and at times comes in contact with and ignites the gas therein. The cylinder is then closed air-tight, and the flame is prevented from communicating with the gas in the cylinder. The gas continues to flow into the cylinder, for a short space of time, then it is stopped off; during that time, by its combustion it acts upon the air within the cylinder, and at the same time a part of the rarefied air escapes through one or more valves; and thus a vacuum is effected. The vessel or cylinder is kept cool by water. Several mechanical means may be contrived to bring the above combination into use in effecting the vacuum with inflammable gas; and on the same principle it may be done in one, two, or more cylinders, or vessels. Having a vacuum effected by the above combination, and some mechanical contrivance, I have, by its application to machinery, produced powers in several ways. I now proceed to describe the different kinds of machinery by which—first, I turn a water-wheel—secondly, I raise water—and thirdly, I work pistons."

The plate represents a front view of the engine as used for raising water, with an over-shot water-wheel attached, for the purpose of giving the primary motion to other machinery. The front part of the frame is removed, to give a more distinct view of the machinery. The cylinders and tubes on each side of the engine are duplicates of each other.

A". A. A'.—Is a beam with circular ends, moveable on the axis A, which is supported on plumber's blocks.

B. B'.—Two metallic cylinder-caps, or covers, connected with the beam by chains and rods, which pass through collars, or guides, at *b. b.*, attached to the exterior cylinders. These caps have metallic valves opening upwards at *m. m.*

C. C'.—Two interior cylinders, open at top, but closed at the bottom; having a lateral pipe *c*, opening by a valve into the trough O.

D. D'.—Two exterior cylinders enclosing the cylinders C. C., and extending to the mains, or pipes, E. E. The outer cylinders rise about an inch above the inner cylinders; so that when the cap B rests on the rim of the cylinder D, there is a free passage for water between the edge of C and the cover B.

E. E'.—Mains, or pipes, extending from the cylinder D, to the open cylindrical water-chambers *e.e.*, on the opposite side of the engine. These mains are furnished with valves V. V., opening upwards to admit water, and closing afterwards by the weight of the water column.

F'. F'.—Hollow metallic *floats*, which rise and fall in the chambers *e.e.* according to the surface of the water in each chamber, alternately.

G. G'.—Two metallic rods connected with the beam, and extending to the surface of the floats in the chambers *e.e.*

T.—A tank, or reservoir, level with the top of the chambers *e.e.*; which tank is supposed to be filled with water.

P. P'.—Pipes leading from the tank to the bottom of the water-chambers *e.e.*, and continued on to join the mains on the *opposite* side of the engine, by the valves V. V.

The communication between the tank and the pipes P. P. is effected by a sliding valve, *v*, which is alternately brought over the orifice of each pipe, by cranks attached to a correcting rod, or chain, which extends to the cylindrical balance above.

H.—A cylindrical balance (or minor beam) moveable on an axis, and, by means of tappets, applied to the rod G. The balance acts simultaneously with the beam A". A'.; whilst it is applied to give motion to the subordinate parts of the engine.

I. I.—A horizontal gas-pipe, in connection with a service-pipe, *i*; communicating to a reservoir, or gas-holder, placed at any convenient distance. The extremities of the pipe I. I. are carried into the lower part of the interior cylinders C. C., where they terminate beneath the surface of the water; having a nozzle, or gas-burner, a little above the surface.

The gas is allowed to enter each cylinder alternately, by the stop-cocks *y. y.*, which are turned by a chain connected with the balance H.

K.K'.—A *minor* gas-pipe, communicating with the gas-holder by the pipe *k*. This pipe is also furnished with stop-cocks *s.s.*, and extended to the side of each cylinder, respectively, where it furnishes two small gas-lights, to be kept burning during the working of the engine.

L.L'.—Two apertures communicating with the interior of the cylinders C.C. These apertures are alternately opened and closed by sliding-valves worked by a vertical arm connected with the rods G.G.

M.M'.—A pipe communicating with the two cylinders for the purpose of admitting atmospheric air after the vacuum has been effected and the water raised. This pipe has two apertures at N. which become alternately opened and shut by the sliding valve *n*, which is worked by a crank and chain connected with the floats in the water-chambers.

O.—A trough into which the water is discharged from each cylinder in succession. This trough empties itself into the buckets of a water-wheel Q; or in the absence of the water-wheel, into the tank below.

In order to set this engine in action, nothing more is necessary, than to turn on the gas by the stop-cocks of the pipes I. and K., and light the orifices of the minor pipe at L.L. Suppose the beam to be in equilibrio—by pressing down one of the cylinder caps on the head of the cylinder, the opposite end of the beam will become elevated, and by means of the rod G. will open the sliding valve in the side of the cylinder C., and at the same instant open the stop-cock of the gas-pipe I.; when the gas will immediately rush into the lower part of the cylinder and become instantly ignited from the gas flame at L.L.

But the upward motion of the beam-end A, also opens the sliding valve *v*, (which covered the orifice of the pipe P,) so as to allow the atmospheric air to act on the surface of the water in the tank and chamber *e*.

The combustion of the gas in the cylinder being effected, and the flame having produced a vacuum; the atmospheric pressure on the surface of the water below forces it through the pipe P. into the main E. and cylinder D, and over the top rim of the interior cylinder C. filling the whole of the interior cylinder. But whilst the water is passing up the pipe and main, it also drives upward the float F.; which by its rod G. forces up the end of the beam, and of course brings down the opposite end so as to close the cylinder with the cap B. air tight. It is therefore the extinction of the flame by closing the top of the cylinder, which actually produces the vacuum; whilst at the same instant the water from below rushes up with vast rapidity to fill its space in the cylinder; at the same time driving out the carbonic acid gas of the combustion, by means of the small valves in the cover opening outwards. The water is discharged from the cylinder into the trough, by admitting the atmospheric air through the horizontal pipe M.M. This is effected by the minor beam drawing the slider of the valve at N. immediately the cylinder becomes filled with water. The air rushing in, relieves the pressure on the cap B. and allows the reciprocal action of the beam and floats to proceed for the alternate stroke; whilst the water by its own gravity descends from the cylinder through the pipe and trough, to be applied to a water wheel or any other arrangement requisite for economical purposes.

[Such is the best account of this invention which we have been able to procure from the London Journals. In some respects, however, it strikes us as being very imperfect.

The atmosphere, in point of bulk, consists of exactly one part of oxygen to four parts of azote; hence, supposing we operate on 30 cubic feet of air, 6 of those will be oxygen, and the remaining 24 will be azote. The utmost possible vacuum, therefore, which we can produce by the annihilation of the oxygen, would be represented by a column of 6 inches of mercury, where the pressure of the atmosphere is represented by one of 30 inches.

For the complete combustion of oxygen, there are only three gasses (or mixtures of them) which we can readily employ: these are, *hydrogen*, *carburetted hydrogen*, and *olefiant gas*. Now, 6 feet of oxygen, require, for their complete combustion, 12 cubic feet of hy-

drogen, 6 cubic feet of carburetted hydrogen, or 2 cubic feet of olefiant gas. Now, 12 cubic feet of hydrogen will convert all the 6 cubic feet of oxygen into water, which condenses on cooling; 6 cubic feet of carburetted hydrogen, converts 6 cubic feet of oxygen into water, which condenses, and into 3 cubic feet of carbonic acid, which, of course, occupy the place of 3 of the cubic feet out of the 6 of oxygen which have been consumed; and 2 cubic feet of olefiant gas, yield, also, water, and 4 cubic feet of carbonic acid, occupying the place of 4 out of the 6 of oxygen. Hence, out of 30 cubic feet of air, hydrogen causes a condensation of 6 cubic feet; carburetted hydrogen, of 3 cubic feet; olefiant gas, of 2 cubic feet. Consequently, what of the air is left after combustion by hydrogen, should exercise a pressure of 24 inches of mercury; after that, by carburetted hydrogen, a pressure of 27 inches; and after that, by olefiant gas, a pressure of 28 inches.

But, according to the London Journals, the remaining air exercises a pressure of only 6 or 8 inches. Now, either this is not true, or there must be some other very powerful cause operating to produce so considerable a vacuum. Coal gas, being very nearly carburetted hydrogen, will produce a rarity which will be represented very nearly by three inches of mercury. This is the whole effect that can be produced by the consumption of oxygen by coal gas. Whence, then, the other 20 inches of rarity talked of by the London Journals? Though they are pleased to talk as if the whole effect were produced by the consumption of oxygen, only about one-eighth part of the effect which they mention, can be produced by this cause. Another eighth is probably produced by the rarefaction of air by heat, and the remaining six-eighths, or three-fourths, are produced by the condensation of watery vapour, which immediately takes place when the gas light is put out, and the cylinder begins to cool. Properly speaking, Mr. Brown's engine is a *steam engine*, and not a *vacuum engine*, as it has been called. Want of thorough information on the subject, prevents us, in the mean time, from speaking farther of it with confidence; but as a modification of the steam engine, neither its construction, nor its economy, will, in its present state, warrant us in pronouncing it an improvement.—M. N.]

DESCRIPTION OF A NEW PROCESS IN SHAWL MANUFACTURE.

Mr. Editor,—On receiving Number XXXVIII. Vol. II. of your Magazine, my curiosity was aroused by your Notices to Correspondents. A description of my townsman's invention was what I anticipated in the following Number, but you may guess my disappointment on finding (last Saturday) a repetition of what has appeared in the *Glasgow Chronicle* long since. I am willing to allow that Mr. Buchanan deserves all the praise which he has received, and I do not object to you giving your aid in making known the claims of any individual by whose ingenuity the manufactures of our country may have been improved; but I am convinced, that a description of the improvement would have better suited the pages of a Scientific Journal. The notice in your last Number bears such resemblance to a newspaper puff, and the assertion at the end, "that the process is hitherto kept secret," being not altogether agreeable to facts, I consider that it would be doing injustice to you, and abridge the usefulness of your Magazine, were you not put in possession of a truer statement.

The fact is, that I know many places where these goods are made, and I do

not know a single shop shut on account of it. Were it really kept a secret, it would be unfair to expose it; but, while it is known to hundreds of persons who are not engaged in the manufacture, it seems strange that it should be called a secret.

The process by which the manufacture is carried on is after this manner: A piece of Turkey gauze,* woven with considerable intervals between each splitful of warp, is cut up through the centre of each interval; this forms the weft for the new fabric. Before it is used, however, a slight twine is thrown upon it, so that the cutted weft which projected from the splitful of warp in only two directions, is now seen projecting on all sides like the hairs of a bottle brush, *si licet parva componere magnis.*

The warp of the new fabric is similar to that of the former, and has induced some manufacturers to fear, that the slightness of its texture would prevent the demand for the new manufacture from becoming permanent and steady. This may be counteracted, perhaps, by its showy and beautiful appearance.

The making of the weft, as far as I have described it, is an old process; and was done, and figured with, nearly forty years since, under the direction of Mr. Wilson, father of Mr. James Wilson, Silk Manufacturer in Back Sneddon Street, Paisley.

In the new manufacture, this weft is thrown into the web at intervals of two or three shots of common silk or cotton; these shots are hid by the shag of the cheniel, as the manufactured weft is called. When the shawl is to be figured, the first fabric has to be wrought of various colours, and much praise is due to Mr. Buchanan, and others engaged in this manufacture, for taste in the contrivance, and ingenuity in the execution, of some of these patterns.

In this department, some secresy is observed, but it consists chiefly in hiding their patterns from each other—a practice quite common with rival manufacturers in every branch of fancy weaving. It is also pretended that the manner of finishing is a secret, but the shawls of a good weaver will not require much secret operation.

Thus have I endeavoured to show that the invention of Mr. Buchanan is not such a secret as strangers will suppose from the notice in your last Number; and, in doing so, I have been actuated by no malice against the inventor, or any person engaged in the manufacture, but, as people are apt to judge of your account of other matters by those with which they are acquainted, I felt for the honour of a favourite work, as well as for my townsmen, who might decide erroneously on its general correctness, and have thus meddled with a subject which previously held out nothing to interest me.

I am, Sir, your's, &c.

S. L. C. A.

Paisley, 5th Oct. 1824.

[Too much praise can scarcely be given to our candid, though, at the same time, smart Correspondent. His observations are very just with respect to Mr. B.'s conduct, and we are greatly obliged to him for such a description as we certainly expected from the inventor or improver of the process. Our surprise was equal to that of our Correspondent, when we were informed that it was a secret; as, in that case, as he very properly remarks, there was no occasion to repeat what had been formerly stated; and our sole reason for so doing was merely to show our willingness to encourage such useful inventions by every due meed of praise, and especially those of *our* great storehouse of manufactures, the "gude town of Paisley."]

* For a particular description of Turkey gauze, see Mr. Murphy's Treatise on Weaving, page 178.

DISPUTED INVENTION.

Mr. Editor,—As I happened to see No. XXIV. Vol. I. of your Magazine, for the first time, last Saturday, I observed a description of a clock made by Mr. William Cooper, Hamilton, who claims the invention of the driving and driven wheel, revolving the *same* way without any intermediate aid; you will therefore do me a favour to state in your useful and ably-conducted Magazine the following particulars:—Being in London, in the years 1822–23, I conceived the idea, that a wheel driving a pinion, and *vice versa*, and both revolving the same way,

without an intermediate wheel, might be of much use in clocks, orreries, and other mechanical combinations. Having made application to several watch-makers and other mechanics, they all declared their inability to understand how it could be done, urging me, at the same time, to make the matter known. As in hundreds of instances two wheels acting this way will perform the work of three, the advantages arising from which are so obvious as not to require enumeration, I therefore addressed a letter to the Society of Arts, Adelphi, dated January 13, 1823, enquiring if they knew of any such invention—to which I received the following reply :—

" Society of Arts, &c. Adelphi,
" 24th Feb. 1823.

" Sir,—In reply to your letter, I am directed to inform you, that Mr. Gampertiz, a few years ago, took out a patent for a method of causing the driving and driven wheel to revolve in the same direction. I understand, however, that there are considerable practical objections to Mr. G.'s plan: yours is probably different; and, as the subject is not only curious, but, in many mechanical combinations, would be convenient, if you choose to send us a description of your invention, illustrated by drawings, or a model, the same will be taken into consideration.

" Ar. Aiken, Secretary.
" Mr. Peter Fenwick,
" 94, White Lion Street, Pentonville."

I therefore did myself the honour to present a model to the Society of Arts, in the beginning of April, 1823, wherein the invention was exemplified in two ways—first, by making the centre pinion or minute-hand axle give the hour, by turning a wheel the same way without any intermediate aid, the teeth being cut in the inside of the rim, which renders minute-wheels unnecessary; secondly, by a wheel and pinion, having their axles parallel, the teeth being cut in the inside as before,—thereby completing the undertaking offered to the notice of the Society of Arts in my first communication.

I hope I have expressed myself with sufficient clearness for any person to see that Mr. Cooper's plan is exactly the same as the second exemplification in my model; at the same time, I expect no person will think I wish invidiously to detract from his merit. I trust you will insert this in the next No. of your very useful and valuable Magazine.

Peter Fenwick, Jun.
Watch and Clock Maker, Crieff.
October 6, 1824.

SCIENTIFIC INTELLIGENCE.

Anatomy.—M. Auzoux, a young physician of Paris, has invented a method of studying the anatomy of the human body superior to that by any imitation with wax. The flexibility of the wax renders it fit to represent the surface of objects; but, the interior parts, which are most wanted for inspection, cannot be surveyed by it. Of course, waxen figures are better adapted to the museum than the amphitheatre. M. Auzoux, with a composition resembling pasteboard, can imitate the human frame, including all its organs, its internal and external parts, with great fidelity. The upper parts are easily displayed, according to the rules adopted in dissection, and the interior are moveable with the like facility. The artificial structure may thus be decomposed into a thousand different pieces, and readily put together again, by means of numerical cyphers attached. The only objection to this process is, that the shades and colouring are not so well shown as on wax, but this, it is thought, may be surmounted. The most minute organs, the nerves, muscles, veins, all the vessels, are completely and correctly exhibited. In anatomical pathology, the effects of any malady will not only be visible on the surface, but the ravages made by it in the interior of the body and the alterations thereby effected. With the aid of variable pieces, the accoucheur may contemplate the different stages of pregnancy, &c. Comparative anatomy, veterinary medicine, and many who are not professionally obliged, and from the fetid scent, cannot attend dissections, will derive no small advantage from this invention.—*Monthly Mag.*

Flame inextinguishable by Water.—The mixture of hydrogen and oxygen gases, in the due proportion for forming water, when issuing from the compound blow-pipe and set on fire, has been found, by Mr. Skinamore, of New York, to be capable of immersion, gradually, *under water*, without extinguishing the flame, but which, on the

contrary, continues its intensity in actual contact with the water, no ways altered, except assuming a rounder form than the flame of this compound gas in atmospheric air.

A method of casting the characters used in Printing in solid Forms or Plates.—This process consists, first, in making moveable characters, the body of which has the form and size of common types, but which, instead of bearing a projecting character turned towards the left, have, on the contrary, a hollow or sunk impression, or engraved character turned towards the right, always exactly of the same depth; secondly, in uniting firmly these characters (which the inventor calls *moveable matrices*) into pages, so as to leave no interval between them; their arrangement being made in the usual method of composing types, and differing only in this, that they are placed in a contrary direction, namely, from left to right; thirdly, and lastly, in casting a solid plate from these united matrices with the greatest neatness.

New Tide Guage.—This proposed guage consists of a pipe with an open mouth, and a triangular orifice at its side, in contact with any convenient part of a bridge or pier, that is situated below low-water-mark. From this pipe is brought another, like those for distributing gas, terminating in a well-closed reservoir, provided with a little forcing syringe, and with an open barometer guage, to which may be added, if necessary, a manometrical guage. Before each observation, the syringe should be worked till the guage becomes stationary, by the escape of the air under the water, so that the column of compressed air may always begin from the level of the upper angle of the triangular orifice; the height of the guage will then obviously indicate the height of the surface of wtaer above this level.

ORIGINAL RELICS OF SCIENTIFIC MEN.

NEWTON'S TRAVELLERS' RULES.

From Sir Isaac Newton *to a young Gentleman,* Francis Aston, *Esquire, about to proceed on his Travels.*

Trinity College, Cambridge,
May 18, 1669.

Sir,—Since in your letter you give me so much liberty of sending my judgment about what may be to your advantage in travelling, I shall do it more freely than perhaps otherwise would have been decent. First, then, I will lay down some general rules, most of which, I believe, you have considered already; but, if any of them be new to you, they may excuse the rest; if none at all, yet is my punishment more in writing than yours in reading.

When you come into any fresh company,

I. Observe their humours.

II. Secondly, suit your own carriage thereto, by which insinuation you will make their converse more free and open.

III. Let your discourse be more in queries and doubtings, than peremptory assertions or disputings, it being much the design of travellers to learn, not to teach. Besides, it will persuade your acquaintance that you have the greater esteem of them, and so make them more ready to communicate what they know to you; whereas, nothing sooner occasions disrespect and quarrels than peremptoriness. You will find little or no advantage in seeming wiser, or much more ignorant, than your company.

IV. Seldom discommend any thing, though never so bad; or do it but moderately, lest you bee unexpectedly forced to an unhandsome retraction. It is safer to commend any thing more than it deserves, than to discommend a thing so much as it deserves; for commendations meet not soe often with oppositions, or at least are not usually soe ill resented by men that think otherwise, as discommendations; and you will insinuate into men's favour by nothing sooner than seeming to approve and commend what they like, but beware of doing it by comparison.

V. If you bee affronted, it is better, in a forraine country, to pass it by in silence, and with a jest, tho' with some dishonour, than to endeavour revenge; for, in the first case, your credit's ne'er the worse, when you return into England, or come into other company, that have not heard of the quarrell. But, in the second case, you may beare the marks

of the quarrell while you live, if you outlive it at all. But, if you find yourself unavoidably engaged, 'tis best, I think, if you can command your passion and language, to keep them pretty eavenly, at some certain moderate pitch, not much hightning them to exasperate your adversary, or provoke his friends, nor letting them grow over much dejected, to make him insult. In a word, if you can keep reason above passion, that and watchfulnesse will bee your best defendants. To which purpose you may consider, that, though such excuses as this, "He provokt mee soe much, I could not forbear," may pass among friends, yet amongst strangers they are insignificant, and only argue a traveller's weakness.

To these I may add some general heads for inquirys or observations, such as at present I can think on. As,

I. To observe the policys, wealth, and state-affairs of nations, so far as a solitary traveller may conveniently doe.

II. Their impositions upon all sorts of people, trade, or commoditys, that are remarkable.

III. Their laws and customs, how far they differ from ours.

IV. Their trades and arts, wherein they excell, or come short of us in England.

V. Such fortifications as you meet with, their fashion, strength, and advantage, or defence, and other such military affairs as are considerable.

VI. The power and respect belonging to their degrees of nobility or magistracy.

VII. It will not be time mispent to make a catalogue of the names and excellencys of those men that are most wise, learned, or esteemed, in any nation.

VIII. Observe the mechanisme and manner of guiding ships.

IX. Observe the products of nature in several places, especially in mines, with the circumstances of mining and of extracting metals or minerals out of their oare, and of refining them; and, if you meet with any transmutations out of their own species into another, (as out of iron into copper, out of any metall into quicksilver, out of one salt into another, or into an insipid body, &c.) those, above all, will be worth your noticing, being the most luciferous, and many times luciferous experiments too in philosophy.

X. The price of diet and other things. And,

XI. The staple commodity of places.

These generals, such at present as I could think of, if they will serve for nothing else, yet they may assist you in drawing up a modell to regulate your travells by. As for particulars, these that follow are all that I now can think of, *viz:*

I. Whether at Semnitium, in Hungary, (where there are mines of gold, copper, iron, vitriol, antimony, &c.) they change iron into copper by dissolving it to a vitriolate water, which they find in cavitys of rocks in the mines, and then melting the slimy solution in a strong fire, which in the cooling proves copper. The like is said to be done in other places, which I cannot now remember; perhaps, too, it may be done in Italy; for, about twenty or thirty years agone, there was a certain vitrioll came from thence, called Roman vitrioll, but of a nobler virtue than that which is now called by that name, which vitrioll is not now to be gotten, because, perhaps, they make a greater gain by some such trick as turning iron into copper with it, than by selling it.

II. Whether in Hungary, Sclavonia, Bohemia, near the town of Filia, or at the mountains of Bohemia, near Silesia, there bee rivers whose waters are impregnated with gold; perhaps, the gold being dissolved by some corrosive waters, like aqua regis, and the solution carried along with the streame that runs through the mines; and whether the practice of laying mercury in the rivers till it be tinged with gold, and then straining the mercury through leather, that the gold may stay behind, be a secret yet, or openly practised.

III. There is newly contrived in Holland a mill to grind glasses plane withall, and I think polishing them too; perhaps it will be worth while to see it.

IV. There is in Holland one Borry, who some years since was imprisoned by the Pope, in order to have extorted from him secrets, as I am told, of great worth, both as to medicine and profit; but he escaped into Holland, where they usually granted him a guard. I think he usually goes clothed in green. Pray inquire what you can of him, and whether his ingenuity be any profit to the Dutch. You may inform yourself whether the Dutch have any tricks to keep their ships from being all worm-eaten in their

voyages to the Indies; whether pendulum clocks do any service in finding out the longitude, &c.

I am weary, and I shall not stay to part with a long compliment; only I wish you a good journey, and God be with you.

Isaac Newton.

Dr. BLACK on AEROSTATION.

Edinburgh, December 2, 1784.

Dear Sir,—I am much obliged to you for your account of Dr. Priestley's late experiments on water. I have also received from Mr. Watt a copy of his paper on that subject. But, as you mentioned the birth of ærostatic experiments, I beg leave to communicate to you more fully my thoughts on that subject. In the first place, although what I have already informed you of is strictly true, I by no means set up any claim for merit in the invention of machines for ærial flight and excursions. The experiment with the thin bladder, which I proposed as a striking example of Mr. Cavendish's discovery, was so very obvious, that any person might have thought of it. But I certainly never thought of making large artificial bladders, in order to lift heavy weights, and carry men up into the air by their means. I have no suspicion that this was thought of anywhere before we began to hear of its being attempted in France; and I do not doubt that what has been published in the newspapers, &c. is perfectly true, *viz.* that Monsieur Montgolfier had some time before conceived the idea of flying up into the air by means of a very large bag, or balloon, of common air, simply rarified by fire or flame. This idea being founded on a principle which has long been known, and which has no connexion with Mr. Cavendish's discovery, it is only surprising that M. Montgolfier should not have put it sooner in practice. I suppose, therefore, that though he might have formed the project a long time before, he never was roused into an exertion for making the trial until others began to talk of flying by means of inflammable air. Who first thought of this method I cannot tell, for I confess I did not read the histories of these experiments; they never interested me in the least. The hopes that means might be discovered for moving these machines at pleasure, and directing their course in the air, could only be formed by those who did not consider and understand their nature. The only circumstance which enables them to subsist in the air, is, that however brisk the wind may be, as soon as they rise they are in effect perfectly becalmed; I mean that there is not the least perceptible motion or impulse of the air against any part of them. This is perfectly evident from their situation; they float in mild air, and have no hold on any thing else; the air must therefore carry them along with a velocity equal to its own, the machine of itself can make no resistance; but, while it moves along with the air, it cannot feel any motion of the air against it in any direction, it must, therefore, be in effect, in a dead calm, the motion of it cannot be perceived by them who are carried by it, except from the apparent motion with which the surface of the earth seems to slide away from them. This tranquillity of the air, with respect to them, is one circumstance which contributes to that composure of mind which many of those have felt who have mounted with balloons. I can imagine, however, that in a hot climate, when the weather is perfectly calmed, the sun shining bright, a large balloon ascending with considerable velocity, may occasion a whirlwind, and may be involved in it, which might be attended with dangerous consequences to those who accompany it; you will easily understand how this may happen. But, in other circumstances, there is no danger of such an accident, the air will not offer the smallest violence to the balloon, but will carry it along like a feather, without making the least impression on any part of it; and this, as I said above, is the reason why it is able to subsist in the air, for it is necessarily made of such flimsy materials, that it is quite unfit to sustain any considerable shock or impression of the air on it; and this, among other things, shows the folly of attempting to give it motion at pleasure, or to command its motion and direction when it is up in the air; for, besides the impracticability of finding a power that can be applied to produce this effect, although the power were found, any attempt to make use of it would destroy the balloon, by impelling it against the air, and exposing it to such shocks and violence as it cannot bear; and, further, in attempting to use such a power, it must necessarily happen, on account of the great surface of the balloon, and the resistance

the air would make to its motion, that the men and machinery by which it were moved, must of necessity go foremost, and the large bladder, &c. would be dragged after them in an horizontal direction, which would require an apparatus totally different from what has been contrived.—Your's, &c.

JOSEPH BLACK.

Dr. James Lind, Physician at Windsor.

Monthly Mag.

BERTHOLLET'S ELEMENTS OF THE ART OF DYEING, &c.

(Continued from page 154, Vol. II.)

THE following are some examples, with developments, which cannot fail to interest dyers.

Grey Course for 100 *pounds of Cotton.*

Scouring in a soda liquor at 1½°, or with the waters of *degraissage* at 2°.

Dung bath, with 25 pounds of dung, and six pounds of oil—stove-drying.

Dung bath,—idem—drying—idem.

White bath, with five pounds of oil, and soda liquor, at 1°, 1½°, or 2°—drying.

White bath,—idem—drying.

One or two salts, the first at 2°, the second at 3°—drying.

Degraissage in pure water, of a temperature equal to that of the atmosphere in summer, and 15° and 18° Reaumur (66° and 72° Fahr.) in winter. The cotton is kept in the water for an hour or two. It is then taken out, wrung at the jack, and dried.

White bath, as above.

White bath, idem.

White bath, idem.

Degraissage, as above, with this difference, that it is washed well before wringing, and then dried.

First galling, with seven pounds of galls in sorts, or galls of Istria—drying.

Second galling, with fourteen pounds of sumach, which is just brought to boil; it is then refreshed (with cold water), passed through a sieve, and the cotton is turned through as hot as possible—drying.

First aluming, with thirteen pounds of purified alum; it gets next a slight washing, but is not dried.

Second aluming, with twelve pounds of the same alum—thorough washing—wringing—no drying.

Maddering, with seven quarters of a pound of Provence lizari for every pound of cotton. Only twenty-five pounds are dyed at a time, which must be allowed to cool after coming out of the boiler before it is washed; then it is to be wrung, *but not dried.*

Brightening, with soda liquor at 1½°, or with what remains of the water of *degraissage;* to which three or four pounds of white soap may be added. The cotton must be boiled for four or five hours in a copper closed with a cover, but not so tight as to hinder the steam from escaping. The ebullition is to be kept up, till a pattern, which has been observed from time to time, has reached the proper point. The cotton is allowed to cool in the boiler, is then well squeezed, washed in the river, wrung at the jack and pin, and, without drying, subjected to the next operation.

Rosing, with twelve pounds of white soap, dissolved in a sufficient quantity of water. When the soap is dissolved, there is poured into the copper a solution of a pound or a pound and a half of tin in two pounds of lukewarm water, to which about a third of a bottle *(bouteille)* of nitric acid at 36° of the areometer has been added. It is made to boil for four or five hours, and the cotton is withdrawn whenever a pattern has attained the proper hue.

If the first rosing do not bring the cotton to the desired tint, a second similar to the preceding may be given; but only eight pounds of soap should be employed.

Yellow Course, in like manner, for 100 *pounds of Cotton.*

Scouring, as in the grey course.

Two baths of sheep's dung, each along with five or six pounds of oil—drying.

Two white baths, each with six or eight pounds of oil—drying.

Two salts, each at 2° of the *pese liqueur* of Baumé.

Degraissage, as usual—washing—then drying.

First galling, with eight pounds of nut-galls—drying.

First aluming, with thirteen pounds of pure alum—washing, without drying—wringing, and drying.

Three white baths, each with six pounds of oil—drying.

Two salts, each at 2°—drying.

Second galling, with four pounds of galls, and twelve pounds of sumach—drying.

Second aluming, with thirteen pounds of pure alum—drying.

Washing off the alum very carefully—wringing—drying or not, at pleasure.

Maddering, with two pounds of lizari of Provence per pound of cotton.

Brightening, as in the grey course.

First rosing, as in the grey course.

Second rosing (if wanted), as in the grey course.

The system of operations indicated in either of the above courses, appears to M. Vitalis so preferable to every other, that he wishes dyers to follow them, leaving them always at liberty to give baths a little more charged with oil, more of them, or some additional salts, &c.

The grey course is usually followed for making the ordinary Adrianople reds; and the yellow course is reserved for reds of the first quality, in point of lustre and durability.

It is also by the yellow course that linen or hemp must be treated.

EXPERIMENTS ON TEA.

"The muse's friend, Tea does our fancy aid,
Repressing vapours which the head invade."—*Waller*.

THE following experiments, made in the laboratory of the Royal Institution, were chiefly undertaken with a view of ascertaining whether the different effects usually attributed to black and green tea, are referable to any peculiar principle existing in the one which is not to be found in the other. They will tend to throw some light upon the relative composition of teas of different prices. To ascertain the nature and extent of adulterations of any kind is not our present object; the various specimens submitted to examination were obtained from most respectable sources, and undoubtedly genuine as imported; what processes the tea may be submitted to in China, or what mixtures and additions it may there receive, are curious and interesting matters of inquiry, and deserve further investigation than they have as yet received.

Experiments with Black Tea.

One hundred parts of the finest black tea sold in the shops at 12s. per lb. were digested in repeated portions of boiling water until it entirely ceased to act upon the residue; the leaves were then dried, and were found to have lost thirty-five per cent. in weight; they retained their original colour. The infusion was evaporated, and yielded a dark brown transparent extract, very astringent, and of a nauseous bitter flavour.

The leaves, exhausted of all their matter soluble in water, were digested in alcohol, (sp. gr. 820°,) to which they imparted a deep brown colour, and considerable odour of tea. The alcohol being evaporated, yielded a resinous extract of a more agreeable smell and flavour than that obtained by water. The leaves were now colourless, and without the smallest remaining taste; they were dried and had sustained a further loss of twelve per cent.

One hundred parts, therefore, of the finest black tea contain forty-seven parts of soluble matter, thirty-five of which are taken up by water, and twelve by alcohol.

A solution of isinglass was carefully added to the aqueous infusion of one hundred grains of the same black tea, as long as it caused a precipitate, which, being dried at a temperature not exceeding 212°, weighed twenty-eight grains.

The above experiments were repeated with a sample of the commonest black tea sold at 6s. per lb. The weight of the soluble matter imparted to water was precisely similar, nearly 35 grains from 100; but the leaves, having been exhausted by water, only imparted six grains of soluble matter to alcohol. The flavour of the aqueous extract was nearly the same as that of the former two.

A variety of samples of black tea were submitted to distillation with water, but the distilled water had acquired in all cases a very slight vegetable flavour only; it contained no appreciable quantity of vegetable matter, and was not obviously different from tea of different degrees of excellence.

Experiments with Green Tea.

One hundred parts of fine green tea digested in repeated portions of water, sustained a loss amounting to forty-one parts; the leaves being separated and dried, still retained a greenish brown colour. The infusion, carefully evapor-

ated, afforded a brown transparent extract, highly astringent and bitter, and having a peculiar flavour unlike that of the original tea.

The residuary leaves of the last experiment were transferred to alcohol, with which they formed a green tincture; when the whole of their soluble matter was thus withdrawn, they were dried, and were then of a pale straw colour, brittle, and quite insipid. They had sustained a further loss of ten parts.

The alcoholic solution being evaporated to dryness, yielded a highly fragrant olive-coloured resinous extract, scarcely acted upon by cold water, but perfectly redissoluble in alcohol. Its solution diluted with water became turpid, and deposited a pale olive-green precipitate of a slightly bitter flavour, and smelling very strongly of green tea.

One hundred parts, therefore, of the best green tea contain fifty-one parts of soluble matter, forty-one of which, having the properties of tan and extractive, are imparted to water; and ten subsequently abstracted by alcohol, of a resinous nature.

An aqueous infusion of one hundred grains of the same tea was mixed with solution of isinglass; the precipitate, when rendered as dry as possible by a temperature not exceeding 212°, weighed thirty-one grains.

A series of similar experiments were made upon a very inferior sample of green tea, sold at 7s. per lb. This only imparted to water thirty-six per cent. of soluble matter; but the leaves, subsequently digested in alcohol, lost eleven grains; so that the entire soluble contents of the good and bad tea, are to each other as 51 to 47; but as far as the mere agency of water is concerned as 41 to 36.

Green tea was mixed with water and submitted to slow distillation; the liquid which passed over had acquired a little of the fragrancy of the tea, especially of the finer samples, but not the smallest portion of essential oil, or other vegetable matter could be detected in it. *

The above experiments show that the quantity of astringent matter precipitable by gelatine is somewhat greater in green than black tea, though the excess is by no means so great as the comparative flavours of the two would lead one to expect. It also appears that the entire quantity of soluble matter is greater in green than in black tea, and that the proportion of extractive matter not precipitable by gelatine is greatest in the latter.

Sulphuric, muriatic, and acetic acids, but especially the first, occasion precipitates in infusions both of black and green tea, which have the properties of combinations of those acids with tan. Both the infusions also yield, as might be expected, abundant black precipitates with solutions of iron; and when mixed with acetate, or more especially with subacetate of lead, a bulky buff-coloured matter is separated, leaving the remaining fluid entirely tasteless and colourless. This precipitate was diffused through water, and decomposed by sulphuretted hydrogen; it afforded a solution of tan and extract, but not any trace of any peculiar principle to which certain medical effects of tea, especially of green tea, could be attributed.

One property of strong infusions of tea, belonging equally to black and green, seemed to announce in them the presence of a distinct vegetable principle; namely, that they deposit, as they cool, a brown pulverulent precipitate, which passes through ordinary filters, and can only be collected by deposition and decantation; this precipitate is very slightly soluble in cold water of the temperature of from 50° downwards, but it dissolves with the utmost facility in water of 100° and upwards, forming a pale brown transparent liquid, which furnished abundant precipitate in solutions of isinglass, of sulphate of iron, of muriate of tin, and of acetate of lead; whence it may be in-

* "I distilled half-a-pound of the best and most fragrant green tea, with simple water, and drew off an ounce of very odorous and pellucid water, free from oil, and which, on trial, showed no signs of astringency."—LETTSOM'S *Natural History of the Tea Tree*, London, 1799, 4to.

Some of Dr. Lettsom's experiments would seem to show that the noxious effects of tea are referrible to the volatile and odorous principle which thus passes off in distillation; and he thinks that those who suffer from them, but yet cannot omit this favourite beverage, might take it with more safety if previously boiled for a few minutes to dissipate the fragrant principle. In all the forms which Du Halde relates for administering tea as a stomachic medicine among the Chinese, it is either ordered to be boiled, or otherwise so prepared, as to dissipate its fragrancy.

ferred to consist of tannin, gallic acid, and extractive matter.

When tea leaves have been exhausted by water repeatedly affused, the above experiments show that alcohol is still capable of extracting a considerable quantity of difficultly soluble matter; this substance, again infused in boiling water, dissolves with difficulty, furnishing a liquid which smells and tastes strongly of tea, and which, were it not for the expense of the solvent and the trouble attending its separation, might perhaps be profitably employed.

Though the above experiments show that tea contains, upon an average, from thirty to forty per cent. of matter soluble in boiling water, it is not to be supposed that so large a proportion is taken up in the ordinary process of making tea; on the contrary, from tea leaves in the state in which they are usually thrown away, there is still contained from ten to fourteen per cent. of soluble matter, capable of affording a sufficiently pleasant beverage, though it must be granted that the most agreeable portion of the tea, consisting probably of the purer tannin, or astringent matter, and of the whole of the aroma, is taken up by the first affusion of hot water; and that, subsequently, the bitter and less soluble extractive matter are dissolved, furnishing what is usually called *strong tea*, but infinitely less agreeable than the earlier infusion. Hence it is that the real epicure in this article imitates, in some measure, the Chinese process of infusion; and only drinks the first made tea, using a fresh, but small proportion of the leaves for each successive cup.

The following table shows the respective quantities of soluble matter in water and in alcohol, the weight of the precipitate by isinglass, and the proportion of inert woody fibre in green and black tea of various prices; it is given, not as throwing any important light upon the cause of the different qualities of tea, but as containing the results of actual experiments; it may also perhaps save some trouble to future inquirers.

One Hundred parts of Tea.		Soluble in Water.	Soluble in Alcohol.	Precipitate with gelly.	Inert residue.
Green Hyson,	14s. per lb.	41.	44.	31.	56.
Ditto,	12s.	34.	43.	29.	57.
Ditto,	10s.	36.	43.	26.	57.
Ditto,	8s.	36.	42.	25.	58.
Ditto,	7s.	31.	41.	24.	59.
Black Souchong,	12s.	35.	36.	28.	64.
Ditto,	10s.	34.	37.	28.	63.
Ditto,	8s.	37.	35.	28.	63.
Ditto,	7s.	36.	35.	24.	64.
Ditto,	6s.	35.	31.	23.	65.

Journal of Science.

VARIOUS COMMUNICATIONS.

ON LIGHTING CHURCHES.

SIR,—In your last Number, a Correspondent wishes to know "whether it would be better to light a Church by one single large chandelier, or by several smaller ones."

To have one "large single chandelier" suspended in the centre of a Church, with the whole brilliancy of the intended minor ones concentrated in it, is certainly preferable. Who does not know, that, when we are placed between two lights, we must, especially if we want to read, reject the one in order to enjoy the other? Just as many rival *beauties*, in counterview, divide our attention and regard. Who does not know, that, by placing four candles in the centre of a room, we find it infinitely better lighted than by transplanting the same four glimmerers into each corner? And is there not reason to believe, that were our great Luminary, our "diurnal star," divided into two or more orbs, and scattered over the horizon, ancient *Night* would have a far better prospect of re-

gaining her "old possessions?" So God, creator wise, in nought to be forestalled, well knew, and, therefore, rather into one translucent globe, circumscribed our light! "wise are all his ways." But, Sir, if, of some Churches, the unhappy construction renders it necessary to have many chandeliers, we presume (if to be wiser than a whole generation, one dares presume) it would be fully as philosophical to have them arranged at given distances, hard by the wall. Of this mode, a man of no uncommon expansion of mind, may see the propriety; for the light, by this means, will not only communicate itself, as if poured in by broad day, but also receives, by being reflected from the transparent wall, vast adventitious potency, and shade and darkness thus hemmed round, necessarily quit the premises quite, and leave the Church, as every Church ought to be, a receptacle of light.

The form and fashion of this grand chandelier we will not, Mr. Editor, take upon us to prescribe; this would be infringing upon the active ingenuity of Mr. Liddell, under whose "forming hand" we cannot help conceiving already something pyramidical growing.

Sir, your's, &c.

L. M'L.

Coll, October, 1824.

If Churches were built, as they ought to be, in a circular, or elliptical form, one or two chandeliers, placed in a central, or focal situation, would serve all the purpose of many lights, not only more effectually, but they would almost double the effect; as it is well known that every particle of light would be reflected to the centre, or foci, and would again emit their rays to the surrounding walls.

CHRONOMETER.

A Chronometer has four hands on the common centre; A makes a revolution in 24 hours; B in 25 hours; C in 30 hours; and D in 44 hours; the hands all pointed to 12 mid-day when the machine was set in motion. After moving for a number of days, it stopped; the hand A pointed then precisely to the 5th minute; B pointed to the 24th minute; C pointed to the 40th minute; and D pointed at the half hour (or 30th minute.) How long did the machine continue in motion?—and at what o'clock did it stop?

Rusticus.

SCALES.

Will any of your Correspondents be so good as to reduce 2534 in the octary scale, to a vulgar fraction, in our common notation?—and also tell me what 5765, in our common notation, is in the scale of $3\frac{1}{2}$?

Rusticus.

MECHANICAL PROBLEM.

It is required to find a situation (for they are numerous) to which the hands of a clock may be removed, where they will continue to distinguish the time as distinctly as if they had remained in the centre?—J. F.

Your Correspondent's clock, with only two wheels, I should wish to see described.—J. F.—[So should we.—*Ed.*]

DRY-ROT.

Mr. Editor,—I had occasion to lay down a new floor and sleepers in a house about three years ago, which is now so much decayed by the dry-rot, that several people have gone through it. I will thank any of your many Correspondents who will suggest a means for the cure or prevention of it.

I am, &c.

J. W.

Glasgow, 4th October, 1824.

DISTANCE QUERY.

A Shorter and Simpler Solution.

The *time of meeting* is evidently the desideratum in the problem, *that* being found, the rest follows of course.

Let x be the time of meeting, and l and s, the longer and shorter sections of the road. Then G.'s time on $l = x$: H.'s $= 2$: : G.'s time on $s = 1$: H.'s $= x$; therefore, $x : 2 :: 1 : x$, and $\sqrt{2 \times 1} = x = 1.4142$, time of meeting; from which it appears, that although there is no royal road to Geometry, there are some much shorter than others.

G. B.

QUERIES.

1. A pole, 63 feet high, is broken over by the wind; the top strikes the level ground, 21 feet from the root; at what height did the fracture take place?

2. A tapering tree, 24 feet long, is 4 feet diameter at the root end, and 2 feet

at the top; at what distance from the root must it be cross-cut, so that the cubic contents of the two sections will be equal?

3. When the full moon is near the meridian altitude, if you ask the question at several persons what apparent diameter she appears to them to be, you will rarely find two that will agree on that point; nay, so widely do they differ, that I have found the moon's apparent diameter to extend from a crown piece to the end of a hogshead. Could any of your numerous and intelligent Correspondents assign the cause of this curious fact; or is there any *specific* apparent diameter the moon ought to present to our vision from her known size and distance from the earth?

I am, Sir, your's, &c.

G. B.

Hamilton, October 5, 1824.

A METHOD OF HARDENING WOOD FOR PULLEYS.

After finishing the pulley, boil it seven or eight minutes in olive oil, and it will become as hard as copper.—J. R.

METHOD OF OBTAINING SKELETONS OF MICE, FROGS, &c.

If a mouse or a frog, or other like animal, be placed in an ant-hill, it will be devoured in a few days to the bones and ligaments. Hence we are furnished with a method of obtaining skeletons of those animals, exquisitely beautiful, and perfect, and far surpassing any thing that can be executed by artificial anatomy. The subject for this purpose is to be enclosed in a wooden box, and properly distended, to prevent the parts from collapsing or being crushed together by the earth. The box is to be perforated with a number of holes, through which the insects will presently find their way.

J. R.

GLASGOW GAS-WORKMEN'S INSTITUTION.

"Whence is this power, this foundress of all arts,
Serving, adorning life, through all its parts,
Which names impos'd, by letters mark'd those names,
Adjusted properly by legal claims,
From woods and wilds collected rude mankind,
And cities, laws, and governments designed?
What can this be, but some bright ray from heaven,
Some emanation from Omniscience given?"—*Jennyns.*

Sir,—It is gratifying to the philanthropic mind to contemplate the many opportunities afforded in our public institutions to the artizan, to obtain an intimate knowledge of those principles of science which are essential to the arts and manufactures. There are, however, many operatives without the boundary of these privileges, and it may not be uninteresting to some of these to hear of the existence of a society of minor extent having the same end in view, though with limited means, but with the most satisfactory effects resulting from its operations. Such associations are worthy of being imitated by our friends in the country: and it certainly would be enlightened policy in the proprietors of works and manufactories to give every encouragement and facility to their operatives in establishing institutions of the kind alluded to, where the mind may be improved and instructed in the principles of science and philosophy—circumstances which may ultimately prove a powerful antidote to those habits of a demoralizing tendency so frequently to be met with in most public establishments.

The society to which I allude, is composed, exclusively, of the workmen employed at the Glasgow Gas Company's Works. About three years ago, Mr. Nelson, the Manager of the Works, with that benevolent spirit for which he is distinguished, suggested to the workmen the great advantage which would accrue to themselves, should they establish a library for their mutual improvement. Several of the workmen immediately adopted the suggestion, formed themselves into a society, and framed proper regulations to be observed by its members. Every encouragement was given to these laudable efforts: an appropriate library-room was granted them, and, with the assistance of a few donations of books, their library at the present time has accumulated to upwards of 300 volumes.

At the beginning of the present year, the Directors of the Company observing the great benefit which had already resulted to the workmen from these arrangements, and desirous

of rendering their mode of instruction still more efficient and interesting, and of affording greater facilities for the acquirement of knowledge, with a liberality which does them the highest honour, gave orders that a hall should be fitted up, where the members might conveniently meet to transact the business of the library, and other affairs of the miniature institution, to communicate mutual information, and to make experiments in Chemistry and Mechanical Philosophy. In the prosecution of these views, by their own exertions, and the kind assistance of their friends, the society has now a considerable chemical apparatus in their laboratory, as well as several very valuable and useful apparatus for the illustration of the various branches of science. At the present time, they have meetings twice-a-week, in the evenings, for the above purposes, when one of their own committee alternately officiates, and gives a short explanation, or *rationale*, of the several experiments performed. And, although a luminous train of theoretical reasoning is not here to be expected, yet it shows considerable perseverance and success among the members of their committee, who have improved these privileges so much, as to excite the regular attendance of almost the whole of the members every evening, and to produce among them the greatest attention and decorum, while they observe with becoming interest the result of the processes laid before them. The whole number of workmen permanently employed about the Works are from 50 to 60 men, of which about a dozen only are mechanics, the rest being operatives; of this total, from 42 to 44 have joined the society. They pay a small sum at entry, and a small weekly or fortnightly contribution; which, together with the fines, are the only support of the institution for extending the library and apparatus, and for defraying the expense of experiments. The entry-money is always repaid to any member on leaving the Work.

Thus, a few individuals, under the auspices of their employers, by a small weekly contribution, (which to each in a whole year would scarcely amount to what some of our operatives spend in an evening in a tap-room,) have established an institution, as honourable to their good sense, as it will be profitable to themselves in the acquirement of useful knowledge; and while they are thus edifying their minds, they are insensibly acquiring habits of useful industry and perseverance—habits which bear a wonderful contrast to those which mark the numberless misspent hours of too many in similar conditions of life.

So striking to the truly philanthropic mind is the consideration of the effects of this institution, that a very worthy and learned Judge, who is an ornament to the highest court in the country, condescended to visit its humble walls, and to pass his unqualified eulogium, both on the object of the society, and the manner of putting it into execution; viewing, no doubt, with an eye of expanded intellect, the time when man shall no longer oppress man, but all shall unite in the universal diffusion and enjoyment of that knowledge and liberal feeling which is the true end of his existence.

Should this short detail in any degree stimulate either masters or men to exert their influence in their respective situations, for the formation of similar societies, the object of the writer will be gained.

I am, Sir, your's, &c.

K.

October 5th, 1824.

NOTICES TO CORRESPONDENTS.

C. North's (Wakefield,) NEW COPYING PRESS, will be inserted.—J. F. will see that he is considerably superseded in last Number, and of course excuse us; what we referred to in the Hoop Problem was its being written with pencil; why does he not use pen and ink? We cannot be troubled to read it, because it is scarcely legible.—Rusticus is right; we meant the fourth question instead of the third.—J. P. need not be in such a pet; we did not accuse him of the emulation he seems anxious to avoid, but which we would be sorry he would lose, as we value his correspondence highly; at the same time, as he well knows, we must be allowed to take our own time and manner of insertion.—P. Q. will be inserted next week.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, and Original Patents, Inventions, &c. will be inserted on the shortest notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of Steuart & Panton, Cheapside, London; and Edward West & Co. Edinburgh.

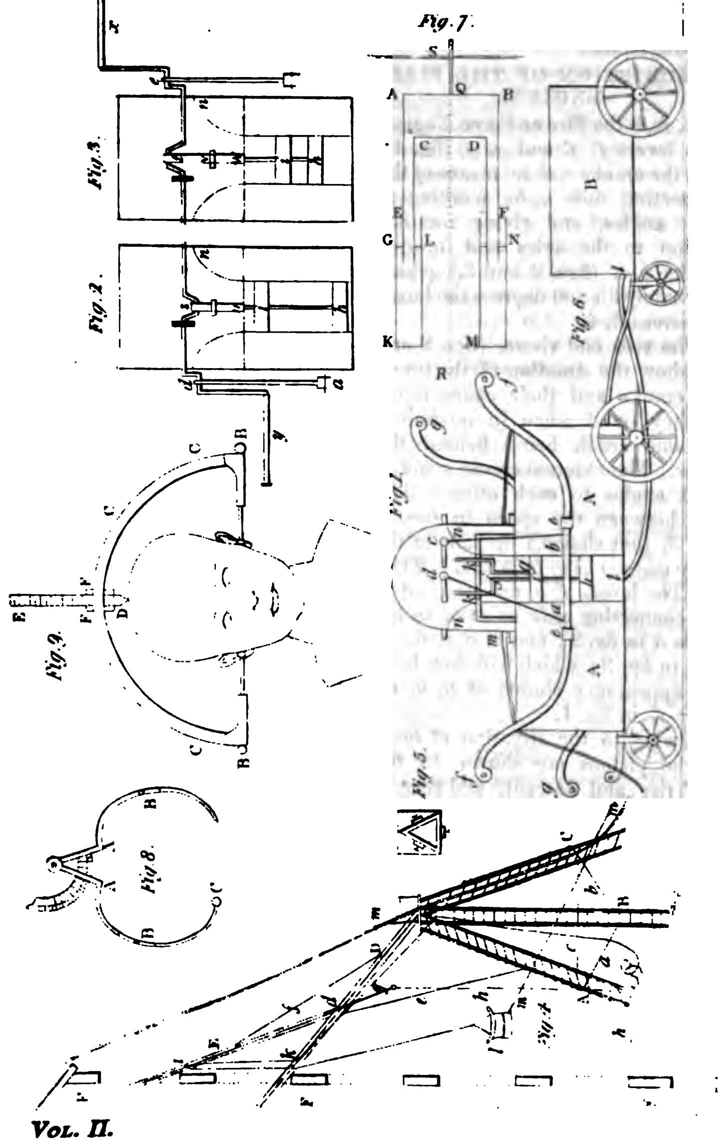
J. CURLL, PRINTER.

THE GLASGOW MECHANICS' MAGAZINE.

" Fire and water are good servants, but bad masters."—*Old Proverb.*

No. XLII. *Saturday*, 16*th October*, 1824. Price 3d.

MR. BALLANTYNE'S FIRE ENGINE AND ESCAPE.



NEW FIRE ENGINE AND ESCAPE,

Invented by Mr. WALTER BALLANTYNE, Water of Leith.

MR. EDITOR,—I submit to your consideration the enclosed drawing of a new Fire Engine and Escape, which, for the good of the public, I hope you will insert in your useful Magazine.

DESCRIPTION OF THE FIRE ENGINE.

A, A, is the Fire or Force Engine. The levers *f, f,* and *g, g,* (fig. 1,) turn the cranks *c, d,* by means of the connecting rods *a, b*; working at right angles, and giving rotatory motion to the axles and internal cranks *s, t,* (figs. 2 and 3,) which alternately lift and depress the boxes or pistons *h, i.*

The two end views, (figs. 2 and 3,) show the situation of the internal cranks and their connections, as they stand when in operation, the one crank being behind the other. The external cranks stand at right angles to each other. The two between the space in figs. 2 and 3, (not shown,) operate in the same manner as *a, b,* in figs. 1, 2 and 3. The levers *f, g,* are attached to the connecting rods as at *a,* in fig. 1, to *a* in fig. 2; and at *g* in fig. 1, to *b* in fig. 3; which will then have the appearance shown at *a, b,* on lever *f,* in fig. 1.

Owing to the situation of lever *f,* the pistons are shown on the half rise and descent, and that of the cranks *s, t,* (figs. 2 and 3,) shows their greatest rise and descent.

The parallel motion of the piston rods, is effected by the friction rollers *k, k,* fixed in the iron standard through which they pass, connected to the cranks *s, t,* by the shears *u, v,* (in figs. 2 and 3,) to the top of the piston rod *j*; where the shears are joined by a bolt through both, taking in the iron standard as at *w,* in fig. 3.

When the engine is not at work, or is to be taken through a narrow passage, the levers *f* and *g,* and the winches *x, y,* are to be detached at *e, e,* and put into the engine carriage; it will then pass through a passage of 2½ feet with ease.

At the extremities of the levers *f, g,* there is a hole into which a round handle of 2 feet in length must be inserted, to enable the men to work the engine.

The boxes are much the same as in all other pumps, except that the box *i,* has a strong division in the centre, through which its rod passes, and is made fast underneath with a screw-nut.

The rod of the under box passes through the centre of the upper, at which there is a piece of leather placed in a particular manner, to make it water-tight.

The valves are hinged to each side of the centre piece, over which there is a cover of leather. The under part of the valve is also surrounded with leather, to make it as tight as possible.

B, is the service-carriage; *r,* its pole or drag. The pole of the engine A, A, is omitted, being well understood.

t t, the service or suction pipe; *m m m,* the force pipe, from the engine to the mouth of the director, at the top of the fire-scaffold.

I have given the scaffold and ladders, simply to show their connection, though not laid down in proportion.

The engine is to be wrought by 8 men at the levers, and 6 at the winches.

DESCRIPTION OF THE FIRE ESCAPE.

The ladders A, B, C, (fig. 4,) are placed together in the form of a triangular pyramid, and fastened at top by means of a square block of

wood, in which are fixed pinching screws for the purpose. The under surface of this block is shown at fig. 5. Each ladder is furnished with a stay, hooked at one end, which goes into an eye in the others, to preserve them in a fixed position. The ladders E and D are hinged together at *d*; the upper end of ladder D is placed against the wall of the building, F, F, F, and the lower end upon the ladder A; and it is raised by means of the stay *e*, and eyes in ladder A, to the position in the figure. By pulling the cord *h h*, the lever *g* is drawn down, and raises the ladder E nearly to a perpendicular position. A person standing on the top of the block, then throws over this ladder to the wall or window, by means of the stay, for the purpose of effecting an escape. To ladder E is attached a block and tackle at *i*, which passes a guide pulley at *k*, and another under the block at the top of the three bottom ladders, and reaches the ground to be worked by those assisting in the escape. The rope attached to the car *l*, passes over the guide pulley *k*: the rope *m*, is attached to the car to keep it off the wall; and into the block at the top of the ladder, is screwed four perpendicular rods, to which are fixed four hooked stays to serve as a rail; from this safe platform, the fireman can direct the water from the engine pipes, with good effect, to those parts of the building where the greatest conflagration is going on, and at the same be free from being incommoded by the crowd.

I am, Sir, your's, &c.

Walter Ballantyne.

Water of Leith, 20th Sept, 1824.

SKETCH OF THE HISTORY OF PHILOSOPHY,

Particularly with reference to Mathematical and Mechanical Science.

(Continued from page 167, Vol. II.)

Circumstances now occurred, which contributed, in a very great degree, to the permanent extension of Mathematical Science in all its branches. After the death of Alexander the Great, his conquests were shared among the companions of his arms. Egypt fell, by lot, to Ptolemy, who selected for his residence the city of Alexandria occupied by a Grecian colony, embellished it, and rendered it the most celebrated seat of learning of which antiquity can boast. A magnificent edifice, called the Museum, was erected, to which men of science were invited from every country, were liberally entertained at the public expense, and were provided with books and instruments for the prosecution of their discoveries. It was farther extended by the munificence of his successors, who founded a vast library, and raised a spacious and well furnished observatory. This royal establishment survived all the changes of fortune during nine centuries, and conferred incalculable benefits on the human race. A succession of the ablest mathematicians threw lustre on the first three centuries of the Alexandrian school. Euclid digested the elements of Geometry into a system, which has stood the ravages of time for 2000 years; and, notwithstanding the improvements in science, seem adapted to stand its severest scrutiny, till time shall be no more. He is said, by historians, to have been a person of courteous and agreeable manners, and was held in very great esteem by Ptolemy, king of Egypt; who one day asked him if there was any shorter method of learning geometry than by his Elements? To

which he replied, "that there was no royal road to Geometry!"

Appolonius, of Perga, extended the Conic Sections, and improved Geometrical Analysis very considerably. Before his time, geometricians were accustomed to derive the conic sections from three different cones, but Appolonius showed how they might all be cut out of one cone, and in these days obtained the title of the "Great Geometrician." In his geometrical discoveries he was followed by Pappus, and by Diocles and Nicomedes, who invented some of the higher curves. Diophantus, a profound genius, applied analytical investigations to arithmetical problems, and the few symbols he used may be considered as anticipations of the perfect system of characters, or pictured language of modern Algebra.

About this period the knowledge of the surface of the globe was extended by a bolder navigation. The Indian sea had been explored by the small fleet of Nearchus, who attended the expedition of Alexander into the East; but the republic of Marseilles, a Grecian colony settled in the South of France, had the merit of fitting out the first voyage of discovery. Euthymenes sailed towards the equator, while Pythias, an able astronomer, shaped his course to the North, discovered Thule, or Iceland, and observed the features of the climate in the frigid zone. He noticed the phenomenon of tides, which are unknown along the shores of the Mediterranean; and, on his return, he made an accurate observation of the obliquity of the ecliptic, which he found to be then 23^{0} 48′.

Sicily had the honour of giving birth to the most inventive genius of all antiquity. According to ancient authors, Archimedes showed, from his infancy, a passion for science; and, having received what instruction his native city of Syracuse afforded, he visited Alexandria, and other seminaries of learning abroad. After his return, he devoted himself entirely to the charms of abstract study, and pursued his profound researches with the most ardent and intense application. He gave unlimited extent to the notation of numbers, and founded the method of indivisibles or exhaustions, which led him to the finest discoveries in geometry, and anticipated one of the grandest inventions of Newton, *viz.* the doctrine of Fluxions, at the distance of 2000 years. He assigned the quadrature of the parabola, approximated to that of the circle, and disclosed the wonderful relations that subsist between the cylinder and its inscribed cone and sphere.*

Archimedes may be regarded as the first who really studied natural philosophy on right principles, and his advances were splendid and triumphant. He detected the fundamental principles of mechanics and hydrostatics, and illumined those branches of science by the torch of geometry. He pointed out the centre of gravity, and determined its position in a number of figures; and he unfolded the properties of floating bodies, and thus traced the rudiments of naval architecture. He reduced his mechanical principles to practice, and constructed such powerful engines as enabled the valour of his countrymen to resist, for three years, the whole efforts of a Roman squadron and a besieging army. Among other prodigies of invention, all the result of his mathematical skill, it is reported that he set on fire their ships in the harbour by means of immense burning

* As the life of this astonishing genius was given very fully formerly, in No. IX, Vol. I. page 135, we shall only glance at his discoveries, referring our readers to that place for a fuller account of them.

glasses, or reflectors; a fact which had always been doubted, till it was practically demonstrated by Buffon.

Geometrical science had now acquired form and consistency. Astronomy was rapidly extending its domains. Aristarchus, of Samos, devised an ingenious method of estimating the relative distance of the sun and moon; and though with his imperfect instruments he could only obtain vague results, yet they were sufficient to expand immensely our conceptions of the solar system.

Eratosthenes next observed, with precision, the obliquity of the ecliptic, and was the first who determined the circumference of the earth, by measuring an arch of the meridian, intercepted between Alexandria and Syene, in Upper Egypt.

Hipparchus, who followed him, was a genius of a much higher order; and, on account of his discoveries, has been called the father of astronomy. He found the exact length of the year, ascertained the distance of the moon, and approximated to that of the sun; he distinguished the unequal intervals of time between the equinoxes, and discovered their precession. This fine discovery suggested to him the idea of ascertaining and registering the positions of the principal fixed stars; he transferred the same method to terrestrial observations, and was the first who defined places on our globe by their latitude and longitude. In this way, he was the first who constructed and furnished the materials for an Almanac and Astronomical Ephemeris; he calculated and foretold eclipses for 600 years. Without rejecting the inveterate axiom of antiquity, that a uniform and circular motion was alone befitting the celestial bodies, he sought to explain the apparent inequalities by the ingenious hypothesis of eccentrics and epicycles, which afterwards so much encumbered science.

Ptolemy, who resided at Alexandria after Egypt had become a Roman province, under the Emperors Adrian and Antoninus, was one of the best and most indefatigable observers that ever lived. Less original in his views than Hipparchus, he laboured with equal zeal to promote astronomy. He not only improved every part of the science, but corrected the errors of Hipparchus and others, and digested the multifarious discoveries that had been made into one great system, which he published under the title of μεγαλη Συνταξις, *or the great construction*, which was the first treatise on astronomy. He discovered the lunar evection and celestial refraction. He likewise composed a general treatise on geography, and applied the theory of projections, which he had invented, to the construction of maps. The study of spherical trigonometry was begun by Hipparchus, extended by Theodosius and Menelaus, but reduced to a practical form by Ptolemy. He adopted and exhibited, in this great work, the ancient system of the world, which placed the earth in the centre of the universe; and this system has been named, after him, the Ptolemaic System, to distinguish it from the Copernican and that of Tycho Brahe. Other philosophers of the Alexandrian school, applied themselves to mechanics. Ctesebius improved the clepsydra, or water-clock, invented the pump, and constructed an engine for discharging arrows by means of condensed air. Hero not only formed the crane, but contrived machines which acted from the variable elasticity of included air, as affected by heat and cold; a principle which afterwards led Galileo and Sanctorius to the construction of thermometers.

The genius of Greece, which had by this time been sinking under op-

pression, at length evaporated in polemical disputes. The Romans had now become masters of the world, and no people, if we regard their contempt for science, less deserved the favour of fortune or the gratitude of posterity. In the whole range of their existence, they never made a single step towards the advancement of science; all the knowledge attained by them in arts or philosophy, they borrowed immediately from the Greeks. Their education was entirely practical, and calculated only to form orators and statesmen; and, after wading through the wide history of their achievements, which filled the world with alarms, it will be found that they have left nothing to posterity but their language.

(*To be continued.*)

ON THUNDER RODS, OR CONDUCTORS.

Sir,—When thunder rods are properly constructed by a skilful person, they form a complete safeguard against strokes of lightning, whether it be thrown off upwards into the clouds, or drawn downwards from the clouds to the earth. Had Nelson's Monument been fitted up with a properly pointed conductor, in all likelihood the electric matter that rushed up through this obelisk, in its way to the negative clouds above it, would have been dispersed without any explosion to the hurt of the building. The effects of this stroke of lightning are visible to this hour, from the pedestal upwards; and, had it been dark, as it was good daylight, when the explosion took place, the whole building would have appeared luminous from top to bottom.

There are three public buildings in Glasgow fitted up with conductors. The first is the steeple of the College, done under the eye of the late Professor Anderson, in the year 1772, and finished, in the most scientific manner, for the purpose of protecting the adjoining buildings, as well as for making experiments with electricity brought down by it. The celebrated electrician, Dr. Benjamin Franklin, at this time in Glasgow, went, with the Professor, to the top of the scaffolding, and gave his entire approbation of the mode of fitting it up. Since the Professor's death, however, this scientific thunder rod has been suffered to fall into disrepair and neglect, the copper rod, tipped with pure gold, that surmounted its top, having fallen down by the wear occasioned by thirty years' constant motion, has not again been put up when the steeple was lately repaired.

The next building with a conductor is the Jail and Public Offices, done, as I understand, by the Superintendent of Public Works, in a way which betrays an utter ignorance of the laws of conducting and non-conducting bodies. This tasteless, and foolishly constructed rod, runs horizontally along the blocking course of the jail and public offices, in iron eyes that have a piece of glass fitted into them, by way of insulation, and within eighteen inches of the leaden gutter that goes round the building for carrying off the water. At the four corners of the building there are four spikes of iron, about eighteen inches long, standing up, by way of points, or thunder rods, and these four spikes terminate their connection in a large mass of cast iron at the back, or west front of the building, that goes down into the burn. By this arrangement, it was meant that when lightning is drawn off by these spikes, it shall run round about along these rods, and down into the burn. But the Superintendent seems not to have been aware, that an estab-

lished law of electricity is, that it always prefers the shortest, and the best conductor, and that glass, when wet, also conducts; therefore the rain that precedes thunder storms, will wet his glass eyes, and the lightning, instead of running round the top of the building to the burn, will go down to the earth, through the first lead rone that is nearest to the point where it is drawn off; so that the jail would have been as well protected without this absurd conductor of the Superintendent's as with it. But still, with a little knowledge of the laws that govern electrical phenomena, this conductor might yet be made both ornamental and efficient.

The third building is the Lunatic Asylum, fitted up also improperly, for the lightning will never follow the direction of the rod, either in this building or the jail and public offices, but take that passage to the earth that is the shortest and best, and this law holds so universally, that it amounts almost to demonstration. On some other opportunity, Mr. Editor, I will point out how the jail conductor may be made agreeable to the eye, without hurting the appearance of the building, and at the same time be an efficient thunder rod.

I am, Sir, your's, &c.

J. P.

Glasgow, 11th Oct. 1824.

On the Prevention of the Concussion of Steam Boats.

Mr. Editor,—It occurred to me that there might be a possibility of counteracting the serious effects of steam boats coming in contact with each other, by the intervention of a strong spring fixed in front of the vessel, and projecting from its bow.

If a spring, made of some strong elastic substance, in the form of a screw, or some other well concerted form, were to be placed in the front of steam boats, it would, when they come against each other, gradually retard their motion, and prevent them from striking with the shock of a battering ram. There might be also a connection from the spring to the engine, so that when the spring comes to be acted upon, it may have the property of stopping the engine.

This suggestion may, perhaps, be useful in leading to the discovery of a plan for mitigating the stroke of a ship upon a rock at sea,* and thereby might, in many cases, prevent the dreadful catastrophe of shipwreck; and, as the slender hand of man hath already controled the lightning of heaven, possibly the time may not be far hence, when the triumphs of art may arm the mariner to conquer his greatest foe of the mighty deep.

I am, your's, &c.

R. M.

Glasgow, 11th Oct. 1824.

* Perhaps by some judicious combination of substantial springs.

COULTER'S PREMIUM FOR INVENTION.

At the suggestion of a Correspondent, we insert the following account of this premium, as it may not be generally known to the Mechanics of this City, and may, perhaps, excite an emulation amongst them to obtain it. With the manner in which it has been hitherto awarded, we are unacquainted, but we can safely affirm, that it was justly awarded when it fell to the lot of James Cross. But, alas! poor man, it came too late; the letter which was transmitted to him, containing the announcement that £10 had been awarded to him for

In reply to G. B. his twisting a copper wire into the sounding line will increase its specific gravity, and bring a certain length of line sooner to an equilibrium with the lead, and of course increase its apparent swimming; a greater improvement would certainly be to use a heavier lead.

To sound to the depth of five, ten, or fifteen thousand feet, lines cannot be used with accuracy, for the reasons I have already given; recourse must, therefore, be had to other methods, which will readily suggest themselves to the philosophical experimenter.

The air in a cylinder, if let down in the water thirty-three feet, will be compressed one-third of its first bulk, and so on one-fourth, one-fifth, one-sixth.

If there is a ball of copper, the capacity of which is nine times that of a tube, annexed to it, it will be the same as if it were nine times as long. The air will not be forced into the tube till the machine is at the depth of nine columns, or nine times thirty-three feet, that is 297 feet, and then the air contained in it will be compressed within a hundredth part. Suppose it to have descended 199 columns, then the air will be compressed within 1-200dth part of the whole; and, in this case, the machine will have descended 6567 feet, that is one mile and 1287 feet. Suppose it to have descended 399 columns, then the air will be compressed within 1-400dth part of the whole, that is, within an inch and a quarter of the top of the tube; and, in this case, the machine will have descended two miles and a half, wanting thirty-three feet. For greater depths, a larger globe may be used.

A machine, upon this principle, may be constructed in the following manner: Into the bottom of the copper tube, let there be a glass bason with mercury. Into the bason set an empty barometer tube, open at both ends, having some treacle, or other adhesive colouring matter, put into the lower end of it. Let a large stone be attached, by a delicate spring, to the lower end of the machine; and, when properly adjusted, let it drop into the ocean. It is evident it will go to the bottom, whatever may be its depth; and, by the pressure of the water on the surface of the bason of mercury, it will be pressed up in the tube in proportion to the depth it sinks; and, whenever it touches the bottom, the spring slips out, and lets the stone fall off, and the ball and barometer tube will rise immediately to the surface, where, by observing how high the treacle has been carried on the top of the mercury, a calculation can be made of the depth the machine has been at. In this way, soundings may be taken which it is impossible to do with a lead and line, and this machine will measure depths equally well whether in dead water or in a current. From this short sketch of my ideas, I have little doubt but that some of your ingenious Correspondents may make improvements.

I am, SIR, your's, &c.

J. P.

Glasgow, 6th September, 1824.

HIGHLAND MODE OF TANNING.

SIR,—In no clime, or country, is *Nature*, unsophisticated Nature, seen so much to advantage as in our own good *Highlands*. Here every man is his own tanner—every man is his own flesher—every man is his own shoemaker—every man is his own barber—in short, every man, generally speaking, is every thing!

This fact, Mr. Editor, lest any should haply call in question, please permit me primarily to divulge our mode of *tanning:* At every recurring Candlemas, then, before cattle begin to forego their rotundity, almost every family, from certain prudentials, divest one of the lowing tribe of a *hide*. This hide, we, by-and-bye, overspread inside with common lime, then fold it together, and to preclude all ingress of foreign matter, enclue it with cordage; this done, we inter the ponderous ball in a bog, there to remain for two months; after which, being lifted and untied, its whole harvest of hair may, with no great labour, be reaped! And now to the *moors* we betake us, to ransack the bowels of the earth for a certain root, called, in our own good and copious language, *Neonan*, (I can't render it;) this root we wash, and pestle, and boil, and in the juice deposit the hide; here it may lie for two weeks; only, it must, at intervals be taken out and scraped; after which the stale juice is ejected, and the process repeated till the sagacious operator say, 'tis enough. But that we confine ourselves solely to the forecited root, let none suppose; the bark of oak we know to be far preferable; but the bark of oak grows on trees—trees here, we have none, and importation belongs to expense; but with the exception of boiling, the process is the same. Now, Mr. Editor, lives

there a whig, we would ask, so stupidly whiggish, as call this "cheating the King?" Let any unbiassed mind but recount the process, and then say if there be in it ought illicit? Our hides are our own; our moors, in the interim, are our own; our feet are susceptible of cold. Nature has taught us how to cover them. Taught by the same kind mother, we contrive to make a universal cordial, and this too she would fain call illicit. Strange! may not one render his milk into cheese or butter; his meal to flummery or bread; and so suit his produce to his palate. We, too, are friends to Loyalty and Law—of *Law*, right reason ought to be the standard.

"We would no statute good subvert,
But still we think one may convert
(So Reason says, nor says untrue)
His corn to bread or mountain dew."

Your's, truly,

L. M'L.

Coll, October, 1824.

PHILOSOPHICAL QUERIES.

1. What is the reason that a fluid, for example oil or water, when made to run from any aperture, as the mouth of a pipe, assumes the form of an inverted cone; that is, becomes gradually narrower as it recedes from the aperture and approaches the ground?—P.

2. What is the *true* cause of the flow of water through a syphon? as the reason commonly assigned is doubted by Q.

3. What is the cause of the change of tone or sound, from low bass to high treble, which takes place in the filling a cylindric vessel with water issuing from a pipe or other aperture?—R.

4. A ship, from lat. 43° 46′ N. sailed on a direct course, between the North and West, 272 miles, and made 231.5 miles difference of longitude; required the course steered, latitude come to, and her departure from the meridian?—G. D. R. N.

5. What distance must a ship sail S. S. W. from a port in lat. 52° N. before her latitude becomes equal to her difference of longitude?—G. D. R. N.

6. There are 77 horses entered for the Doncaster St. Leger stakes, and the odds betted against some of the favourites stand thus:

7 to 2 against Brutendorf.
7 to 1 against Jerry.
14 to 1 against Swiss.
20 to 1 against Equity.

Would it be an equal bet to lay *even* on the first *three* in the above list, against the field? or, in betting upon them against all the others, what odds would be required?—T. A.

7. Given the distance of a tree, from three successive corners of a square field, to determine its area without Trigonometry or Algebra; let the distances, for example, be 180, 340, and 115 yards respectively?—J. M.

8. Situated at the top of a hill, I was desirous of ascertaining its height;—knowing the distance between two remarkable objects on the horizontal plane below, I took the angles of depression of each, and also the *angular* distance between them; will any of your Correspondents favour me with a general formula to find the height of the hill from these data?—D. B.

9. The object glass of the large achromatic telescope at the Glasgow Observatory, is 66 inches in focal length for parallel rays; its eye-piece for terrestrial objects, is composed of four glasses, with the following focal distances; the first, next the object glass, is $1\frac{1}{4}$ inches; the second, $3\frac{1}{4}$ inches; the third, $3\frac{1}{4}$ inches; and the fourth, or eye-glass, 2 inches. The distance between the first and second is $4\frac{1}{2}$ inches; between the second and third, $5\frac{1}{4}$ inches; between the third and fourth, or eye-glass, $3\frac{3}{4}$ inches: required the magnifying power for parallel rays?—D. B.

SCIENTIFIC INTELLIGENCE.

DROSOMETER, OR DEW-MEASURER.

A person in France has contrived an instrument for estimating the quantity of dew deposited at various times of the year. It is a circular tin-plate, about $9\frac{1}{2}$ inches in diameter, with a border about $\frac{1}{2}$ of an inch in height; it is painted with oil paint of a grey colour, and supported on a stick in the midst of a garden, about $3\frac{1}{2}$ feet above the earth. It was examined every morning at sunrise; if it contained dew, the liquid was carefully put into a phial of known

weight and weighed; the portion adhering to the moistened surface was estimated, from the result of many experiments, at 30 grains, and added to the weight of that in the bottle. If the drosometer was merely moistened, so as not to run with fluid, the quantity was estimated at 30 grains; if it was less, an estimation was made as nearly as could be done, by judging of the quantity. The weight being ascertained, it was compared with a table constructed from the weight of a known column of water, of equal diameter with the instrument; by which means the inventor considers, that the thickness of a coat of dew may be ascertained to about the $\frac{1}{34000}$ part of an inch.

INSTRUMENT FOR EXAMINATIONS UNDER WATER.

An optical instrument for seeing through water and examining the bottom of rivers, has been constructed by Mr. Leslie of Lausenburgh, U. S. It consists of a conical tube of variable length, about one inch broad at the top, and ten inches at the bottom. It is glazed at both ends, and when the broad end is immersed to some depth in water, and the eye applied to the narrow extremity there is no interruption to, or deflection of the rays of light coming from objects in water to the eye, and if the water be clear, whatever is in it, may be seen with the greatest facility. For use in the night, it is fitted with lamps suspended near the bottom, in a shorter outer cylinder, sliding on over the tube, and secured at its lower extremity; the mouth of the cylinder is glazed, so that the light of the lamps placed in it is thrown into the water and illuminates objects in it. Two tubes go to this close cylinder, one entering at the bottom, the other at the top; the one carries fresh air down, the other conveys the smoke and foul air upwards. The instrument is very useful in the speedy recovery of drowned bodies or of lost property; in examining the beds of rivers, or other situations under water, to facilitate excavation, and on many other occasions.—*Journal of Science.*

PRIZE QUESTIONS,

Proposed by the Royal Academy of Sciences.

Astronomy.—A method of calculating the perturbations of the elliptical motions of comets, applied to the determination of the approaching return of the comet of 1759, and to the motion of the one observed in 1805, 1819, and 1822. The prize—a gold medal of 3000 francs value, to be adjudged in June, 1826.

Natural Philosophy.—1. To determine, by multiplied experiments, the density acquired by liquids, and especially mercury, water, alcohol, and ether, by pressure, equivalent to that of many atmospheres. 2. To measure the effects of heat produced by those pressures. The prize—a gold medal, 3000 francs in value, to be adjudged in June, 1826.—3. To determine, by a series of chemical and physiological experiments, what are the successive phenomena that occur in the digestive organs during digestion. The prize—a gold medal, 3000 francs in value, to be adjudged in June, 1826.

M. Alhumberts' Prize.—A gold medal of 300 francs in value, to be adjudged in 1825. Subject: To compare anatomically the structure of a fish, and that of a reptile, the two species to be at the choice of the candidates. A second medal of the same value will be adjudged in 1826. Subject: To describe with precision the changes to which the circulation of the blood in frogs is subject, during their different metamorphoses.

Geographical Prizes.—The Geographical Society of Paris has announced the following prizes. A medal of 3000 francs value, under certain conditions, as an encouragement for travels in Africa, to be adjudged in 1826. A medal of 1200 francs value, on the subject to ascertain the direction of the mountain chains of Europe, their ramifications, and successive elevations throughout their whole extent, to be adjudged in 1825.—A medal of 1200 francs value, for researches on the origin of the various races of man spread over the islands of the ocean to the south east of Asia.—*Journal of Science.*

TREE WHICH PRODUCES THE CAOUTCHOUC, OR ELASTIC GUM.

In the region of the Mississippi, on the Arkansas and Red River, grows the tree which yields the vegetable caoutchouc. It has a tolerably smooth back; and, when incisions are made in it, a milky fluid exudes, which coagu-

lates, and forms elastic gum. Some trees yield from 150 to 200 pounds of caoutchouc. Mr. Bringier observed, that the wood of it was very elastic, when dry. If rubbed on a body which is electric, particularly in a cold day, the body rubbed will adhere to the wall. A quill, for example, will be attracted six inches from the wall, and stick fast to it, till all the electricity is dissipated.

DESCRIPTION OF THE CALLIPERS AND CRANIOMETER,

For Measuring the ORGANS of the BRAIN, discovered by PHRENOLOGISTS.

THE opportunity at present afforded in this city for the study of Phrenology, by attendance at the Lectures of the learned and enthusiastic President of the Phrenological Society, Mr. Combe, has induced us to give a description of the mechanical instruments employed in the elucidation of the science.

The callipers are shown at fig. 8. The numbers on the scale indicate the width in inches when the instrument is opened. They are employed to ascertain the general size of the head. The legs are sometimes made to unscrew at A, A, and are fitted with hinges at B, B; the instrument can then be put into a small case, and carried in the pocket. The ball C, is inserted in the orifice of the ear, when measurements are taken from it to different points of the head.

The craniometer, or, in other words, skull-measurer, is shown at fig. 9; it was invented by Mr. Ellis, simplified and improved by Mr. Gray, and has, in its present form, met the approbation of the Phrenological Society. The use of this instrument is to measure the length of the space from the "medulla oblongata," or top of the spinal marrow, where each organ originates, to the point where it reaches the surface of the brain. The rods B, B, are moveable, and the balls, (made of ivory or brass,) in the inner ends of them, are placed in the external opening of the ear. The point, when these balls meet, is the middle of the axis, or centre, and coincides very nearly with that of the "medulla oblongata." The rods must be inserted to equal depths into the ears, otherwise the centre of the instrument would not coincide with that of the head. The rods are graduated to insure accuracy in this respect. C, C, C, is an exact semicircle, (made of steel or double plates of tin,) of which the centre is the point of meeting of the rods. D, E, is an index for the purpose of measuring distances from the centre. To ascertain if it is accurately constructed, make the end D touch the centre, and the other end will, if it is so, coincide with every part of the circumference of the semi-circle. When the index is drawn out, the end E rises as far above the circumference as the end D recedes from the point A. The index is graduated from the top, and the measurements are read off as they appear on the projecting part.

The semi-circle moves backward and forward on the axis B, B, and the index is moved from right to left along the circumference. To keep the index always pointing to the centre, it is made to slide in a piece of wood, F, F, the sides of the grooves of which form a segment of a circle coinciding with and applied to the circumference of the semicircle. This instrument measures only the length of the organs. Their breadth is judged of, by their expansion at the surface; and the two dimensions give their absolute size; by the combinations of these, the effects of the different organs are represented.

HARVEST HOME.

In the ceaseless revolving of time's flying hours,
The Spring is no more with her verdure and flowers;
She is gone, robed in blossoms, and fanned by soft gales,
To paint, with fresh beauty, Peruvian vales.

Gone too is bright Summer to southern domains,
To chase the deep snow from Fuego's drear plains;
To cheer the lone savage long wrapt in sad gloom,
And soften the woes of his comfortless doom.

Kind Autumn, their fruit-giving sister, is gone
To tinge the rich fields of a far distant zone;
And soon, in hoar mantle, will Winter appear,
To close the short round of the swift-rolling year.

The warmth-loving swallow, without guiding star,
Has winged its bold flight to the regions afar;
O'er empires and seas steered its perilous way,
To bask in the sun's equatorial ray.

Unheard now the songs, which from forest and lawn,
In the Summer's gay months hailed the joy-giving dawn;
The groves no more echo the blackbird's sweet note,
And his rich varied music the thrush has forgot.

Lone Philomel's tones, which from stillness and night,
Touched the rapture-bound ear with more vivid delight,
Now charm the young Bramin, while darkling he roves
'Mid the freshness and fragrance of Indian groves.*

The goldfinch has ceased to enliven the plains,
The skylark to carol in soul-stirring strains;
The redbreast alone, at the close of the day,
From the half-leafless tree pours his soft melting lay.

The green smiling foliage, the forest that crowned,
Now floats on the stream, or is strewed on the ground;
And fled, like the visions which dreams oft disclose,
The tints of the tulip, and dyes of the rose.

The once daisied mead is now faded and bare;
Less beauteous the landscape, less balmy the air;
And the fields bright with dew, at the op'ning of day,
Stern hoar frost now vails in her vesture of grey.

The sun's radiant orb, in his sky-circling march,
Darts a less potent beam, from a less towering arch;
And oft his effulgence is wrapt in the shroud
Of the slow rising mist, or the dark frowning cloud.

The moon, long bedimmed by the Summer's bright blaze,
Now silvers the fields by her soft-beaming rays,
And, with millions of stars which the firmament pave,
Lights the mariner's path as he ploughs the dark wave.

Through the cloudless, unbounded and azure expanse,
Majestic she moves, and beholds with mild glance,
Isles, empires, spired cities, the hill's climbing height,
Seas, lakes, and clear fountains reflecting her light.

The orchard is stript of its choice mellow store,
The vineyard looks sad, for the vintage is o'er;
The hook of the reaper has swept ev'ry plain,
Of the ripe, sweetly waving, rich harvest of grain.

O'er the far stretching prospect of upland or vale,
No storm-beaten sheaf mourns the rain or the hail;
In the neat rural cottage wherever we roam,
Is heard the loud mirth of the loved *harvest home.*

To crown this long-wished, sweetest day of the year,
The large table groans with the best of good cheer,
The choice of the dairy, and, grateful to view,
Abundant libations of pure mountain dew.

Arranged at the board, the repast all enjoy,
With hearts full of glee, and with joy-beaming eye;
No prince starred with gems, in his gold-covered dome,
E'er relished his banquet, as they harvest home.

'Tis done. See the ploughman now winged for the dance,
See him steal at fair Helen a love-darting glance;
See the glad rural group, with the jest and the song,
All fond, the gay scene, and short hours to prolong.

Discussed the loved themes, not of wars or alarms,
Not of kingdoms or kings, but of fields and of farms;
Of landlords and leases, of rents or of stock,
Of seed-time and harvest, the dairy or flock.

These joys, and the stores of the bountiful soil,
Make the peasant forget all his hardships and toil;
O'er the large brimming bowl to the winds are now toss'd
All his fears of the rain, blighting mildew, and frost.

Now blow let the loud wind, or pour let the rain,
Or scowl the black tempest o'er mountain and plain;
Or along let the torrent impetuous roar,
And wave upon wave lash the sea-beaten shore.

Let Winter out-pour all her treasures of hail,
Or with snow robe in whiteness the hill and the vale;
He dreads this wild war elemental no more,
His crops are all safe, and his labours all o'er.

From his snug little dwelling, imbosomed in trees,
He sees the dark storm, but undaunted he sees;
With his barn amply stored, and a bright glowing fire,
He recks not its howling, he fears not its ire.

But he sighs for the traveller who houseless must bear,
The pitiless rage of the storm-teeming air;
And he sighs for the sailor who distant from land,
May dashed be on rocks, or ingulphed in the sand.

Uplifted his eye in deep rev'rence and love,
To him who sits throned 'mid the bright choirs above:
Who showers in rich bounty, all Autumn's great store,
And rules the proud billows that break on the shore.

Y. Y.

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* The nightingale, which in Summer is found in many of the woods in England, is said to go in Winter to Asia.

SCIENTIFIC NOTICES, &c.

SEARCH FOR GOLD.

In a certain town within at least 100 miles of Glasgow, the sexton, while performing his melancholy duty, met with a circumstance which may perhaps excite a smile from our *grave* readers. One day, when digging in the Abbey Churchyard, he felt his spade strike against something harder than usual; this excited his curiosity; and, after a good deal of labour, he succeeded in exposing to the light of day an ancient Sarcophagus, on which was rudely chiselled the effigy of its inhabitant, in his pontifical robes and ornaments, as he once appeared in those days when spiritual Rome was in her glory. Suspecting that the tenant, whose peace had been so long undisturbed, might have been buried in these very robes, or at least, that a golden cross, or some such ornament, might have once graced his hallowed corpse, the avaricious sexton began to think of making the best of his discovery. Having waited till the shades of night allowed him to proceed with his deed of darkness, he sallied forth, with his obscure lanthorn, at the dread hour of twelve, to accomplish his intentions. He reached the ancient depository of the dead, and forced open the Sarcophagus, after having all his "strength put to't." No shining robes were there! no golden cross to reward his toil! all was dreary dust and mouldering ashes! Oh, the sinner, did not his heart sicken at the sight? By no means; what then? he proceeded to immerse his unhallowed fingers amongst the sacred dust!—yea, and to drag them searchingly along from end to end, without feeling in the mass of "almost nothinguess" a single particle of the "sordid ore." Was not this sufficient? alas! no! what must the dead now suffer! The avaricious wretch, not content with not fingering gold, procured a sieve! a sieve?—yea, and proceeded to search every particle of dust contained in a chest of softer metal than his "obdurate heart." All was in vain; not a particle of gold could be found; and he was at last obliged to restore the mingled ashes to their peaceful bed, and consign them in a less hallowed state to their ancient habitation. Oh! that the avarice of man should pursue us beyond the tomb, and at the distance of centuries attempt to deprive our ashes of repose. But let us be thankful: had the sexton been a chemist, or alchemist, perhaps the ashes might have been passed through an alembic, and converted into the philosopher's stone. *O tempora! O mores! in sæcula sæculorum.*

GLASGOW WATER WORKS.

It often happens that the first inventor or suggestor of an improvement, reaps very little or no benefit from it himself; and he is well off, if in any case, he escapes obloquy and reproach, for being the first to start a new opinion. This, at least, was not the good fortune of the first propagators of phrenology, though now they are getting into repute; neither was it that of the poor weaver, to whose renown we relate the following anecdote. The Glasgow Water Works Company, at the commencement of their operations on the Clyde, above Dalmarnock, laid out a great deal of money and labour in digging pits and beds, and building walls and reservoirs, and procuring sand to filter the river, to establish a continued supply of pure and excellent water for the health and comfort of the lieges. While they were thus engaged in their mighty operations, one day a poor Rutherglen weaver happened to stroll up the banks to the place where they were carrying on, and began to wonder what was the intention of all the great and laborious works which he beheld; at last, he ventured to inquire at some of the individuals, who were superintending the operations, what they were intended for; when he was informed that they were for filtering the water of the river. This increased his astonishment, and he exclaimed "what is the use of all your labour and expense to make filters for the water on this side of the river, when you have only to cross to the other side, (pointing with his finger,) dig a hole in the natural sand bank, which the river has cast up there, and you will get as much filtered water as you like—aye, and far better than you are able to make it; you have then only to bring it across the bed of the river in pipes, and carry it into the city." Such was the sagacious advice of a poor man who made use of his eyes—and what was the consequence: he was laughed at, derided, and treated with contempt, at the time. No sooner was he gone, however, when they began to think of what he had suggested; and, like wise men, they began to think that what he had said might be

true; in short, they abandoned all their operations—adopted the poor weaver's suggestions—dug their filtering pits on the other side, in the natural sand-bank—obtained pure water—carried it over the bed of the river in pipes—raised it in reservoirs—and sent it at last in tens of thousands of streamlets through the populous city of Glasgow—carrying along with it the greatest blessing, in point of a healthful and plentiful beverage, and a source of cleanliness, as well as a prevention of contagion, that ever fell to the lot of its numerous and industrious inhabitants.

NEW MINERAL WATER.

We wish some of our Correspondents would give us the analysis of the new Mineral Water, or Red Spring, recently discovered on the banks of the Kelvin. We have heard that it is a sovereign remedy for the toothache. A gentleman, who was complaining sadly of this tormentor, was requested to put a spoonful in his mouth by way of trial; when, wonderful to relate, within five minutes thereafter, the pain was wholly removed, and he has never been troubled with it since.

BEAUTIFUL ENGRAVING.

We are happy to announce to our readers the increased pleasure which the lovers of the Fine Arts will have, in a few days, in contemplating a beautifully engraved portrait, being the first thing of the kind that has ever appeared in Glasgow. This engraving, which is a portrait of the Rev. William Shireff, late of St. Ninians, is taken from a finely finished painting in oil by our old friend Mr. Henderson, and has been executed, in the first style of the art, by Mr. Swan—an artist who has already done credit to our city by many specimens of his superior skill. The encouragement he has already received warrants us in expecting, that this *chef d'œuvre* will meet with that meed of approbation and support which it deserves.

PRESERVATION OF COPPER-PLATES.

Dr. Macculloch has pointed out the great injury done to fine engravings on copper, when they are laid aside, from oxidation. In large and expensive works only the impressions immediately required are printed, and the plates are laid aside; after some time, they are worked again, when it is necessary first to remove the film of oxide which has formed; and the repetition of this operation produces great injury, in addition to that done by inking. To prevent this, Dr. M. proposes to varnish the plate, when laid aside, either with common lac varnish—which may be removed, when requisite, by spirit of wine—or with caoutchouc varnish.—*Edin. Jour.*

PATENT.

To Sir James Jelf, *of Oakland, near Newnham, Gloucester, for a Combination of Machinery for working and ornamenting Marble for Jambs, Mantles for Chimney-pieces, and other purposes.*—December 20, 1822.

This is a mode of cutting any description of parallel mouldings upon marble slabs, or blocks, for ornamental chimney-pieces and monuments, and other marble, or stone decorations. The machinery consists of a fixed frame, on which the block, or blocks, are laid and secured, and of a sliding frame, to which the cutting-tool is attached. This cutting-tool is a plate of metal, formed with grooves and elevations, which, by repeatedly traversing to and fro with the aid of sand and water, grinds the surface of the marble slab to the form of the cutter.

NOTICES TO CORRESPONDENTS.

Mr. Ballantyne's AIR VESSEL has been received; his bird's eye view came too late; but the machine will be now well enough understood without it.—Mr. Dixon Vallans' BOAT, WITH WINGS, has been received.—An article on Phrenology next week.—Some other Correspondents' communications have been received, and are under consideration.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, and Original Patents, Inventions, &c. will be inserted on the shortest notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of Steuart & Panton, Cheapside, London; and Edward West & Co. Edinburgh.

J. CURLL, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE.

> ...." Music too,
> From voice melodious, and the varied string,
> Sends out the soul of harmony, like spells
> Spreading enchantment round, 'till vaulted choirs
> Ring with th' Eternal's praise, and men attempt
> What happier seraphs hymn.—Thrice blest the age
> Which virtuous arts adorn! by them the heart
> Grows more refin'd, by them the breast is warm'd
> To nobler deeds, the laws of civil life
> More taught, more studied: brutal virtue turns
> To reason'd courage, and the mind awakes
> To scenes unknown before."

No. XLIII. *Saturday, 23d October,* 1824. Price 3*d.*

TABLE of the GENERAL COMPASS of VOICES & INSTRUMENTS,
Showing the Place each occupies in the Scale.

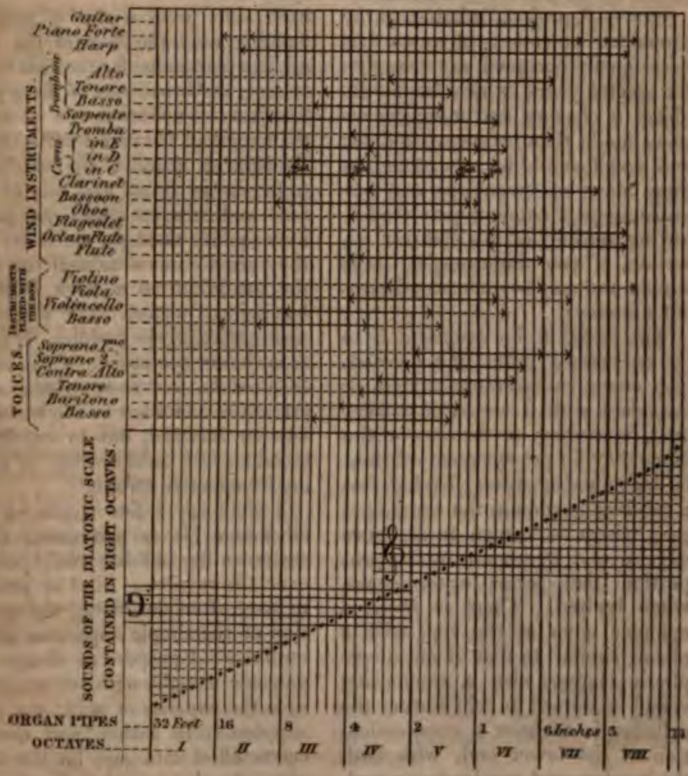

TABLE OF THE GENERAL COMPASS OF VOICES & INSTRUMENTS,

Showing the place each occupies in the Scale.

We have inserted this Table at the request of some Correspondents, who are of opinion that it will be very useful to amateurs and others, for the sake of reference, besides giving a view of the extent of the various instruments and voices in the musical scale. The nature of the Table precludes the necessity of description, as the name of each kind of instrument is engraven on the plate, opposite to the line which shows the extent of its notes. The dots, in some cases, indicate an extension of the ordinary compass of the instrument by artificial means. Any further explanation, to those who are acquainted with the subject, would be perfectly useless; and, to those who are not, a requisite explanation would occupy a greater space than we can properly devote to the sublime science of music.

ON PROPELLING VESSELS BY GALVANISM.

Sir,—A project, relating to the propelling of vessels in water, has occasionally occupied my thoughts for several years, which has for its object a cheaper and more convenient mode than by steam engines; and, lest I should be superseded, in these days of inventions and improvements, I communicate the following outline of my plan for insertion, if you think proper. It is simple, and may be understood without drawings.

The vessel to be propelled is to be converted, under the flooring, into one great galvanic trough, or furnished with a series of smaller ones, according as the one or the other may be proved most efficient in decomposing water; having also a receiver to contain the compound gas, which is known to be pure oxygen and hydrogen, in the proportion that forms water again, when ignited. There is to be a cylinder open at the top, with a piston similar to that of an atmospheric engine; also a condensing vessel immersed in cold water; the cylinder is to have a communication at the lower end, with both the receiver and condensing vessel, with a valve to each. The vessel is to have a narrow platform on each side, with a row of paddles hanging near the sides of the vessel, in a perpendicular position when at rest; the broad part of these paddles is to be as low in the water as the nature of the vessel will permit; the lever or shank of the paddles is to be rather broad and thin at the fore and hinder edges, to move with facility through the water; as they are to move to and fro, like the pendulum of a clock, without leaving the water. The broad, or acting part of the paddles, is to be as far below the surface of the water as possible, and so contrived as to present a thin edge to the water, in moving forward, but to unfold its broad surface in returning or making its effective stroke.

I shall say a few words on the advantage, it is presumed, these reciprocating paddles would possess over the revolving kind at present in use, after describing the operation of the simple apparatus above outlined. I propose to charge the galvanic troughs with sea water, to save the expense of acid; we shall suppose it in action, and the receiver filled with gas; let the valve open into the cylinder, the gas will enter, and raise the piston, which is so connected with the paddles as

to move them forward; which done, shut this valve, and open that into the condensing vessel, where the gas is to be ignited; a vacuum will then be produced under the piston, which will be forced down by the pressure of the atmosphere, causing the paddles to expand and move backwards, making an effective stroke in propelling the vessel forwards; the same process is successively repeated.

It will be observed that the kind of paddles I propose, act on the same principle as wings and fins. A hint, from any thing analogous in the works of nature, will generally point out the best principle for any piece of mechanism. There are fishes with fins, with wings, and with sails; but none with paddle-wheels. What has been considered the greatest defect of the latter, is their not all acting at right angles to the surface of the water, and moving parallel to it, which they should do to produce the greatest effect; but I believe a defect, equally great, is their acting at the surface of the water, where its mobility is so great that a considerable part of the power of the engine is spent in making a splutter, and throwing the water into motion, instead of the vessel. The comparative stability of water, at some depth, is well known to seamen, who sometimes retain a boat in its station by letting down a weight attached to a line, and suspending it, though far from the bottom.

I conclude, from these circumstances, that paddles, acting considerably under the surface of the water, would possess great advantage in communicating motion to a vessel. The primary motion of the reciprocating engine corresponding with the kind of paddles I have described, the power spent in working complex machinery would also be saved, and resemble the simplicity and energy with which the muscles of a fish act upon its fins. It may be farther observed, that the fins of the larger fishes are comparatively small, and must have a very rapid motion to cause them to move with their known velocity; which leads to the conclusion that small paddles, with a quick motion, would be more effective than large ones moving slower; and they could be regulated by the engine's length of stroke, and the lever-proportion of the paddles.

The intelligent reader will perceive that there is nothing problematical in the above plan, except the uncertainty whether or not any vessel would afford sufficient space for such an extensive galvanic arrangement as would, by decomposing water, produce gas sufficient to supply the cylinder of a moderate size and single stroke. This point ascertained, *not guessed*, its failure or success might be pronounced with confidence.

Finally, it may be observed, that the paddles now proposed are adapted to any kind of engine, or other moving power, equally with the galvanic engine; and, that their acting silently below the surface of the water, where they will meet a prompt opposition, renders it very probable that a vessel, so propelled, would do as little injury to the banks of canals as if tracked by horses. It is presumed that the broad part of the paddle, acting at any given distance below the surface, would meet with an opposition directly as the distance to which water would spout from the side of a vessel, through an aperture, at the same distance from the surface.

I am, Sir, your's, &c.

G. M.

Glasgow, 15th October, 1824.

SKETCH OF THE HISTORY OF PHILOSOPHY,

Particularly with reference to Mathematical and Mechanical Science.

(Continued from page 198, Vol. II.)

After the decline of the Roman empire, and the burning of the Alexandrian library, that storehouse of the collected wisdom of ages, Europe had fallen into such a convulsed state, by the irruption of the northern hordes, that science was totally neglected, and every thing gave way to the ravages of war and the overwhelming tide of religious superstition. The Arabians, on the other hand, actuated by the demoralizing influence of a false religion, which had newly sprung up in their quarter of the globe, began to spread the terror of their arms in all directions. Having overrun Egypt, Syria, and Persia, in the east, they turned their attention to the west, made themselves masters of Spain, and, penetrating into the interior of France, threatened at last to extinguish the very name of Christianity. Checked, however, by the rudeness and poverty of the natives, or the inhospitality of less happier climes than their own, and perhaps satiated with the thirst of conquest, they soon abated the fervour of their warlike zeal, and their ambitious enterprises at last yielded to the arts of peace. Fortunately, some remains of Grecian literature and science had escaped the general conflagration of the works of the ancients, and the Arabians, under the influence of a spirit that reflects on them the highest honour, carefully collected all the philosophical writings of the Grecian sages that could be found, and caused them to be translated into their own language. Their princes rewarded such undertakings with unbounded liberality; they filled their palaces with those precious relics of science; and, attracted by *the beauty* of astronomical re*searches, they* adorned their courts by the erection of splendid observatories.

The intimate connection of geometry with astronomy, led the Arabians to cultivate these sciences with ardour; and, wanting the speculative genius of the Greeks, they turned them to more practical utility. By these means, they became expert calculators and accurate observers. To them we are indebted for several useful improvements in trigonometry. They first made use of the sines of angles, instead of their chords, and introduced their tangents into calculations. From them arithmetic took that lasting form which it has since their time preserved, by the introduction of the decimal notation and the ten digits —one of the most important steps that ever was made in the progress of science. This beautiful and simple invention, they did not arrogate to themselves, but acknowledged that they borrowed it from the nations of India. They carried the use of the Indian characters to Spain, whence it was transferred to the rest of Europe.

During these enlightened periods of Arabian history, the fairest portions of Christendom were enveloped in intellectual darkness. The savage arts of war, and the intrigues of a cunning priesthood, had conspired to render man little better than the beasts of prey. His restless and uncontrollable spirit was forced to expend its energies in the severest sports, or the most wanton depredations. Science during these middle ages was reduced to a very low ebb: it was preserved, however, from becoming totally extinct. Some valuable arts, such as the making of paper, &c. owe their origin to this obscure period. The

discovery of the compass, which occurred shortly after, gave a wonderful spring to navigation and commercial enterprise. The mariner, no longer compelled to creep along the shore for fear of losing sight of land, was now enabled to launch into the deep, and pursue his voyage through its pathless waves, alike regardless of his proximity to the coast and the appearance of the stars, which used to regulate his progress. Aided by the friendly needle, man soon ventured to explore the utmost limits of the ocean; and, while wandering in fear and uncertainty, he was guided by an irresistible power to the discovery of a new world.

The thirst for knowledge had begun to make rapid strides, when an invention occurred which may justly be considered the noblest effort of human ingenuity, if we consider that it has conferred by far the greatest benefits ever bestowed on the human race. Those who had studied the manuscripts of antiquity, now saw a field opened for the exertions of their genius, which, till that period, had never been imagined or even anticipated by philosophers. Their most sanguine hopes for the means of advancing a knowledge of science was infinitely surpassed. The labours of the press speedily increased the copies of the valuable monuments of ancient learning; but it required the erudition and the skill of man for a century afterwards to digest and correct the precious remains. The powers of original genius were for a time suspended by the reappearance of those immortal compositions; but, at length, they burst forth with renovated vigour. "This day-spring of reason," says an elegant writer, "may be dated from the middle of the sixteenth century; since which epoch, the tide of discovery has flowed in a rapid and majestic stream. Philosophy and the arts have advanced together, reflecting mutual lights. Little more than two hundred years have elapsed; but it has been a period of extreme activity, investing our species in a blaze of intellectual glory."

Though the mathematical sciences had suffered in the same "palpable obscure," which had thus happily been dispelled, yet they had never been totally neglected, and, upon the revival of learning, they were the first to experience a renovation. Though there were individuals, no doubt, in the very darkest ages, who could calculate the area of a triangle, draw a meridian line, or erect a sun-dial, yet, till the period which we have described had arrived, the demonstrations of a Euclid, an Appolonius, or an Archimedes, were like a sealed book even to the learned. That this should have been the case, will not appear surprising, when we consider that men had just begun to feel their strength, and were far from that mature vigour which had carried the geometry of the Greeks to such a pitch of perfection as appeared in their writings. Euclid had connected the elementary truths of that science into one great chain, which all the force of sophistry found it impossible to break. He had begun with definitions and axioms of the simplest possible kind, and had extended them in the most gradual manner through all the properties of regular figures and simple solids, till he reached the ultimatum of the five regular bodies; and he had arranged the whole in such admirable order, and demonstrated them with such consummate skill, precision, and clearness, that though many improvements were attempted, they uniformly failed, and left his work unrivalled to this day. What Euclid had left undone, was, by the

labours of Archimedes, nearly completed, as far as the instrument which these ancient geometers employed could be carried. This instrument, known by the name of the Method of Exhaustions, had enabled Archimedes to demonstrate many curious and important theorems respecting the rectification and quadrature of curves and the cubatures of solids. With him had also originated the elementary principles of physico-mathematical science, and the first determination of the fundamental propositions and problems in mechanics and hydrostatics.

The conic sections owed their simplest origin and demonstration to Appolonius, and geometrical analysis, had been carried by the successive labours of the followers of Plato, and this original geometer to very great perfection. This branch of the Mathematics, however, had suffered more during the ignorance of barbaric times, than perhaps any other, and its want was just about to be felt as an instrument of invention, when the analytic art sprung up to supply its place. Great as the advances were which the Greeks had made in geometry, by means of this lost art, (for it has never been fully restored,) there seems to have been limits to its powers. Whether, if it had descended pure and uncorrupted to later times, it would have been a more powerful instrument of investigation, may be fairly questioned, and has been by many denied. The invention of Algebra, which was brought into Europe from Arabia, has proven in the hands of the moderns a much more powerful instrument, and has, we believe, led to more wonderful discoveries in Geometry, as well as in the physical sciences, than could have been accomplished by the ancient analysis.

The science of Trigonometry, which was, for want of a commodious method of calculation, almost entirely unknown to the Greeks, had, as we have seen, received its form from the Arabians; and, in the fifteenth century, advanced under the industry of Regiomontanus or Muller, a famous mathematician of that period, to nearly as great a degree of perfection as that in which it exists at present. Arithmetic owes to him, by the introduction of decimal fractions, the complete extension of the numerical scale, and the utmost degree of simplicity which the practice of calculation is capable of attaining. Science now began to receive that honour which was her due, and this eminent man experienced at his death, that share which perhaps few would have been willing to bestow during his lifetime.

The commencement of the seventeenth century was particularly distinguished for the greatest advance in the higher geometry since the days of Archimedes, and one which ultimately pointed at what was afterwards to be accomplished by Newton. The ancients had invented the method of Exhaustions, a method which consisted in continually approximating to the areas of curves, or the contents of solids bounded by curve surfaces, until at last they arrived at their exact determination.

(To be continued.)

ON THE CULTURE AND MANUFACTURE OF INDIGO IN THE PROVINCE OF BENGAL.

(For the Glasgow Mechanics' Magazine.)

1st. Description of the Plant.

The Indigo grown in Bengal is a straight plant, small, and furnished with thin branches, which, by spreading out, form a tuft. It grows to the height of about four feet high,

and even six and seven feet, when on good ground, free from weeds and vermin; and then its principal root shoots perpendicularly into the earth. That root, and the others which issue from it, extend fifteen or eighteen inches deep; they are white, round, ligneous, hard, and crooked. This plant, which in time becomes woody and brittle, sometimes divides itself, from the very foot, into small stems, covered with a skin of a greyish colour, intermixed with light green. The stems, as well as the stalks, are round; the latter, according to the soil, may be half an inch diameter, more or less. The inside is white; the branches are provided with smaller stalks, bearing four pair of leaves, terminated by a single one at the extremity. The leaves are oval, a little pointed, smooth, soft to the touch, and very like those of clover. The foliage of Indigo diffuses a sweet smell, pretty penetrating, but not very pleasing. The leaf has a little sharp bitterness of taste, of which the whole plant partakes. The branches fill with small blossoms, of a very light reddish colour, and of a faint but agreeable smell. To these flowers, nearly resembling our heather, but smaller, succeed pods of about an inch long, and the eighth part of an inch in diameter, that are stiff and brittle, round, seedy, and a little curved.—These pods contain six or eight seeds, of a cylindrical form, and of about the twelfth of an inch in length, shining, very hard, and of a brownish colour. Indigo is easy to manufacture, but the success of its plantation is very doubtful. The tender stalks are exposed to many accidents; from the moment they begin to shoot, the rain, wind, and sun, all seem to conspire to destroy them; even the ground upon which it grows seems to refuse it assistance; if it has been much used, the plant will linger, and produce but stalks that perish as they appear. One of the principal causes of its loss is the *scorching;* that is, the accident to which it is liable, when, after a shower of rain, the sun suddenly shines and darts its hot rays on the ground; the water, which has not had time to penetrate, heats so much, that the young and weak plant, extremely sensible at the root, droops, fades away, and is burnt up.

2d. *On the Sowing, and proper Season for it.*

The lands being all prepared, and well ploughed, to be ready for the north westers, or heavy squalls of wind and rain from the north west, which happen in the month of March, it is the best method to sow (which is done the same way as wheat or corn is in Europe, by broad cast,) as much seed (12 lbs. of seed is enough for an acre, but some people sow 15 and even 18 lbs.) as can be conveniently done after the second squall; this generally happens, in this part of the country, about the 20th or 25th of March, or the beginning of April. The sowing should, by no means, take place when the ground is hot and dry; for, though a heavy shower may moisten the soil, it does not sufficiently cool the ground to receive the seed; and it is most probable that both the seed and labour will be lost, through heat killing the sprouts as soon as they shoot, and the land must then be ploughed and sown again; although the resowings very seldom succeed well. The latter part of March, and beginning of April, is the best time for sowing; but the whole crop should be sown before the month of May commences, provided the weather is not so hot and dry as to render it impossible. When the soil is good, and the plant kept free from weeds, the leaf will be rich

and the produce in proportion; but, if neglected, and the weeds be suffered to abound, the plant will be weak and sickly, the leaf thin, and the produce small. The medium produce from a beger, or one-third of an acre of plant, should be about three surs, or six lbs. of Indigo.

3d. *Of the proper time of Cutting.*

The Indigo plant is generally fit to begin cutting about the beginning of July; although, in some places, they commence, when danger is apprehended from the inundation, about the 15th or 20th of June. Before commencing, the most forward plant ought to be inspected, to see if it is thoroughly ripe; and, by always taking that which is ripest first, the plant which is farthest behind will have time to come to perfection, and be ready for the sickle by the time the other is finished. To know if the plant be ripe enough to cut, we examine where the branches join to the stock; and if, in the upper part of that joint, the buds begin to appear, the plant is fit to cut; and, when these buds come out full, and blossom with a small red flower, the plant is at its greatest perfection, and will then yield the most produce. There is another way to judge of the plant, which is by the substance of the leaf. Take a leaf from one of the plants, and double it back, with the point towards the stalk; and, if it is fit for cutting, it will break short across the middle of the leaf when pressed; but, if unripe, it will bend flat together, and not break. This last is a good way of judging, when the plant is on good ground, and the foliage luxuriant; but, in a poor exhausted soil, where the plant is weak, the leaf has seldom sufficient substance in it to break. In this case, the buds coming out, is the only way to know the degree of ripeness.

4th. *On the Process for obtaining the Dye.*

The method used for extracting the dye is fermentation and beating, which is conducted in two-storey-built brick cisterns, or vats, which are placed like two steps of a stair, the floor of the one being elevated above that of the other about two feet; the highest of which is generally built twenty feet square and three feet deep, and is called the *steeper*, because in it the fermentation is conducted. In the middle of the wall, between the two vats, at the bottom of this cistern, there is a small plug-hole, through which, when the process of fermentation has finished, the fluid is run off into the lower cistern, which is denominated the *beater;* because in it the process of beating the fluid by paddles, to separate the fecula from the water, is performed; it is always of the same breadth with the steeper, but generally a third longer. The plant is brought into the factory, from the fields, on carts or in boats. As soon as a sufficient quantity to fill one vat has arrived, they begin filling; the plant is then laid, in regular tiers, in the steeper, till it is filled within five or six inches of the top. As it is absolutely necessary to prevent the too great dilation of the herb in the steeping-vat, the edge of which it will soon rise over, there are long irons built into the two side-walls, directly opposite one another; to these, which project about four inches, are fastened, by mortises, made to fit the irons, six posts of wood, six feet long, and rising above the top of the vat about two feet. These posts, which are called the *keys*, have towards their upper extremity a number of small holes; on these posts, three heavy beams, the length of the vat, traverse it by niches made at each end of them. When the vat is loaded, four grat-

ings of bamboo, large enough to cover the surface of the vat, are laid over the plant; and, over these, five or six long bamboos, over all the above-mentioned beams, are let down, and fastened by an iron pin put into one of the holes at the top of the keys. As soon as these beams are secured, the vat is filled, as quickly as possible, with water, which is generally done in about half an hour, with two, three, or four pair of pumps, according to the size of the factory; a factory of twelve pair of vats has generally four pair of pumps and so on. In filling the vat with water, about three or four inches should be left empty, as the liquor will swell so much during the fermentation. After all the vats have been brought into regular use, the fermentation will be completed in ten or eleven hours; though, for the first or second day, they may require thirteen or fourteen hours; but the length of time required, depends greatly on the temperature of the weather. After the plant has been in steep about nine or ten hours, the vats should be visited, and the progress of the fermentation marked; by that time it will begin to swell, and throw up frothy bubbles, which in a short time will rise in little pyramids, white at first, but, after being some time exposed to the air, they grow blue, and then assume a deep purple. The fermentation now becomes more violent, the liquor swells fast, and boils and bubbles up over the whole vat. This is the critical time to observe it; any part of the surface, that does not rise in bubbles, is covered with a thick copperish scum. While the liquor continues to swell, you may let it ferment safely; but, as soon as it stops rising, it must be immediately let off into the beater. Great care should be taken not to let it go beyond this point; it is better to be a little under in fermentation than to exceed, as then, though you may lose a trifle in quantity, by properly managing the beating, the quality will be good. The fermentation of vats, in the first or second day's working, does not show those strong bubbling signs, which are constant after vats have been worked some time. The first day's fermentation goes on slowly and silently, throwing up a frothy scum, which rises very slowly, and will probably take 14 or even 15 hours to ferment properly.

(To be concluded in our next.)

SYMPATHETIC INKS.

Among the amusing experiments of the science of chemistry, the exhibition of sympathetic ink holds a distinguished place. These liquids, when written with, leave no visible traces behind: the writing only becomes sensible when some known *re-agent* is applied to it.—We shall here mention a few of these "inks" out of the great number which but a slight acquaintance with chemistry will suggest to the student.—The sympathetic inks may be laid on paper either with a camel hair pencil or a pen; but, whichever is used, it is necessary that the instrument be perfectly clean—the presence of the smallest conceivable quantity of any foreign body will go nigh to spoil the effect. The best thing to employ is a clean fresh cut pen.

1. Write with weak tincture of galls—the characters will be invisible. Moisten the paper with a feather dipped in a weak solution of sulphate of iron—the writing will become *black*.

2. Write with a weak solution of prussiate of potass—the letters will be invisible. Moisten the paper, as in the preceding experiment, with a weak solution of sulphate of iron—the writing will assume a fine *blue* colour.

3. Wash paper with a solution of sulphate of iron, and suffer it to dry; when written upon this paper, solution of prussiate of potass produce *blue* letters, and

tincture of galls *black* ones; but, upon common paper, they make colourless marks.

4. Most acids, diluted, and written with, leave marks which are invisible till the paper is heated, when they become *black;* the heat concentrating the weak acid, and enabling it to char the paper.

5. Write with a weak solution of nitrate of silver, and let the writing dry *in the dark*—it will be invisible; fold up the paper so as to keep the writing in the dark—it will continue invisible; but, expose the writing to the light of the sun—it will become *black.* The nitrate of silver has the property of being decomposed by light; a black colour being acquired by the metal oxide.

6. Characters written with a solution of equal parts of sulphate of copper and muriate of ammonia, have a *yellow* colour when heated; but are invisible when cold.

7. Write with a weak solution of muriate of copper—the writing is invisible when cold, but *yellow* when heated.

8. Write with a weak solution of nitro-muriate of gold, and dry the writing in the dark—it will be invisible. Moisten the paper, by means of a feather or bit of spunge, with a solution of muriate of tin—the writing will then assume a *purple* colour.

9. Write with a solution of nitrate of bismuth—the writing will be invisible. Immerse the paper in water—the characters will then be legible. The water decomposes the salt, and causes the white oxide of bismuth to be precipitated.

10. Expose a paper upon which you have written with nitrate of bismuth, to the vapour of water impregnated with sulphuretted hydrogen—the writing will become *black.* It being the property of bismuth to be thus affected by sulphuretted hydrogen.

11. Let a paper upon which you have written with nitrate of bismuth be moistened with solution of prussiate of potass—the writing will assume a *beautiful yellow* colour: a prussiate of bismuth being formed.

12. Write with a solution of sulphate of copper—no writing will be visible. Wash the paper with solution of prussiate of potass—the writing will then get a *reddish-brown* colour: prussiate of copper being formed.

13. Write with a solution of super-acetate of lead—the writing will be invisible. Hold the paper over a saucer containing liquid sulphuretted hydrogen—the writing will become, first black, and then glittering like silver. The metallic salt is decomposed by the sulphuretted hydrogen, which robs it of its oxygen, and, consequently, the lead is gradually reduced to its metallic state.

14. Digest, in a sand-bath, for some hours, one part of cobalt or zaffre, with four parts of nitric acid, add to the solution, one part of muriate of soda and four times as much water as acid, and filter the solution. This is the green sympathetic ink.

15. Upon a fire-screen let there be drawn a representation of winter, with trees destitute of foliage, and ground covered with snow. Let, however, every part of the picture which, if the scene represented summer, would be green, be covered with the sympathetic ink, No. 14. Draw, for instance, leaves on the trees, and grass on the ground. These marks will not be visible; the picture will still bear the aspect of winter. But, let the fire-screen be placed near the fire, *then* the view will exhibit all the verdure of summer. When allowed to cool, the verdure disappears; but it may be again revived, by the same means as before, and that as often as desired—provided, that the paper be not heated beyond a certain point; for, if heated too much, the ink will assume a permanent *brown* colour.

16. Write with a diluted solution of acetate of cobalt (made by dissolving oxide of cobalt in acetic);—the writing will be invisible till the paper is heated, when it becomes *blue.*—*Chem. Recrea.*

VARIOUS COMMUNICATIONS.

CALCULATION OF STEAM ENGINES.

Sir,—In your useful Magazine, Number XXXIX. I find a Table on the calculation of engines. You presume the engine to work at the pressure of 10 lb. upon the square inch of the piston.

But one great omission, in my opinion' is, that you do not say what size of a boiler is necessary to produce such a quantity of steam as to give the pressure. I must, therefore, consider your Table incomplete, until you add another column, mentioning the size of boilers ne-

cessary for each engine, or stating how many inches of area of boiler (at the top of the water,) is allowed to one inch of the area of cylinder.

By inserting the above in your Magazine, I hope a satisfactory answer will be obtained from some of your very numerous Correspondents; and, in so doing, you will confer a favour upon one of your constant readers, and very humble servant,

A FIFESHIRE MECHANIC.

Dunfermline, 12th Oct. 1824.

QUERY.

If the piston of an engine moves at the rate of 220 feet per minute, will engines of the same diameter of cylinder have the same power, whatever be the length of stroke? or, will an engine of a 2 feet stroke, making 55 in a minute, have the same power as an engine of a 3 feet stroke, making $36\frac{2}{3}$ in a minute?

A. F. M.

PERPETUAL MOTION.

SIR,—You will observe by the sequel I am no Mechanic; but as you seem to encourage youthful endeavours, I presume to trouble you with the following. Perhaps some more intelligent Correspondent may improve the hints given, or be able to give a *just refutation* of them. I thought I had discovered the perpetual motion. The method which appeared to me likely to answer, was this:—Place a wheel in a large cistern, so that it may turn round without touching the water at the bottom, and that the water falling upon the wheel may not escape the cistern. Attach this wheel to the end of a beam, or balance, by a crank; to the other end of this balance, attach a pump, or pumps, to raise a sufficient quantity of water from the cistern to drive the wheel; raise this water into another cistern, about double the height of the wheel; below this cistern, place another, containing a wheel of the same size, and in the same situation as the former. The water in the highest cistern would turn this wheel, and the water in the middle cistern would drive the first mentioned wheel, (being lower than the other.) You will observe, the intention of the higher wheel is to drive machinery, as the power of the lower one is exhausted, (or, as I afterwards understood, overcome,) by working the pumps.

I am informed, that a wheel will only raise two-fifths of the quantity of water sufficient to drive itself double its own height. Should this machine be employed, and a steam engine used to raise the remainder of the water necessary, would it not be a considerable saving of coals, instead of using the steam engine as is at present done? And could not friction wheels (I mean two wheels on either side of the power wheels, on which their axis would rest, converting the sliding into a rolling friction,) be employed to lessen the friction of the power wheels?

I am, SIR, your's, respectfully,

M. P.

SOLUTION OF THE WEAVER'S BEAM QUERY.

(See page 599, Vol. I.)

IT is evident that this is nothing more than the area included between two circles, the less being the end of the beam, the greater being the beam with the cloth upon it. Now, according to the question, the thickness of the cloth = $\frac{1}{22}$th of an inch, therefore, each round of cloth will increase the diameter by twice the thickness of the cloth, or $\frac{1}{11}$th of an inch.

By Mensuration.

$$\frac{24}{3.141592} = 7.63944 = \text{diameter of the beam.}$$

$$\frac{1}{11} \times 95 = 8.63636 = \text{differences of the diameters.}$$

$$16.27580 = \text{diameter of the beam with the cloth upon it.}$$

$$((16,2758 + 7,63944) \times 8,63636) \times ,7854 = 162,21698724 \text{ square inches. Hence,}$$

$$\frac{162,21678724 \times 22}{36} = 99,1326 \text{ Yards. } \textit{Answer.}$$

Otherwise by Progression.

$\frac{1}{11} \times 3,1416 = .2856 =$ the common difference or increase of each round.

$24 + \frac{.2856}{2} = 24.1428 =$ the first term.

$24.1428 + (94 \times .2856) = 50.9892 =$ the last term.

$\overline{50.9892 + 24.1428} \times \frac{95}{2} = 3568,77$ inches.

$\frac{3568.77}{36} = 99,1326$ Yards. *Answer.*

A Parkhead Weaver.

SCIENTIFIC INTELLIGENCE.

On the separation of Iron from other Metals.—By J. F. W. Herschel, Esq.—The solution containing iron is to be brought to the maximum of oxidation, which can be communicated to it by boiling with nitric acid. It is then to be just neutralized while in a state of ebullition, by carbonate of ammonia. The whole of the iron to the last atom is precipitated, and the whole of the other metals present (which I suppose to be manganese, cerium, nickel, and cobalt,) remains in solution.

The precautions necessary to ensure success in this process are few and simple. In the first place, the solution must contain no oxide of manganese or cerium above the first degree of oxidation, otherwise it will be separated with the iron. It is scarcely probable in ordinary cases that any such should be present, the protoxides only of these metals forming salts of any stability; but should they be suspected, a short ebullition with a little sugar will reduce them to the minimum. If nitric acid be now added, the iron alone is per-oxidized, the other oxides remaining at the minimum. Moreover, in performing the precipitation the metallic solution should not be too concentrated, and must be agitated the whole time, especially towards the end of the process; and when the acid re-action is so far diminished that log-wood paper is but feebly affected by it, the alcaline solution must be added cautiously, in small quantities at a time, and in a diluted state. If too much alkali be added, a drop or two of any acid will set all right again; but it should be well observed, as upon this the whole rigour of the process depends, that no inconvenience can arise from slightly surpassing the point of precise neutralization, as the newly precipitated carbonates of the above enumerated metals are readily soluble, to a certain extent, in the solutions in which they are formed, (though perfectly neutral). In the cases of cobalt and cerium, this re-dissolution of the recent precipitate formed by carbonate of ammonia is very considerable, and a solution of either of these metals, thus impregnated with the metallic carbonate, becomes a test of the presence of peroxide of iron, of a delicacy surpassing most of the re-agents used in chemistry, the minutest trace of it being instantly thrown down by them from a boiling solution, provided no marked excess of acid be present. To be certain, however, that we have not gone too far, it is advisable, after separating the ferruginous precipitate, to test the clear liquid, while hot, with a drop of the alkaline carbonate. If the cloud which this produces be clearly re-dissolved on agitation, we may be sure that only iron has been separated. If otherwise, a little acid must be added, the liquor poured again through the filter, so as to wash the precipitate, and the neutralization performed anew.—*Phil. Trans.*

Uninflammable Clothes.—M. Gay-Lussac announced in the sitting of the Academy of Sciences, 6th Nov. 1820, that linen dipped in a solution of phosphate of ammonia became incombustible. MM. Merat-Guillot, father and son, apothecaries at Auxerres, have since shown that the acidulous phosphate of lime possesses the same property. In fact, linen, muslin, wood, paper, straw, impregnated with a solution of this salt at 30° or 35° of concentration (1.26 to 1.30), and dried, became absolutely uninflammable, and consequently unfit to communicate fire. They carbonize, or char, when they are exposed to a very intense flame, but the carbonization does not extend beyond the focus of heat in which they are plunged.—*Journ. of Science.*

Paste for dressing Webs.—It is well known that weavers are obliged to work in damp shops, to prevent the dressing of the web from drying and hardening. M. Dubue has read lately a Memoir before the Academy of Sciences at Rouen, on the subject of pastes, &c., in which he shews that a very minute addition of lime to them, renders them so retentive or absorbent of moisture, that webs dressed with such pastes, may be wove in the upper and drier chambers of a house, as well as in the lower and ill-aired with the usual dressing. The plan is undoubtedly judicious. Muriate of lime may be had at a very trifling expense from those apothecaries who prepare water of ammonia. The waste whitening steep of the bleacher is merely a solution of muriate of lime.—*Ib.*

Preservation of Milk.—The following method is recommended for the preservation of milk, either at sea or in warm climates. Provide pint or quart bottles, which must be perfectly clean, sweet, and dry; draw the milk from the cow into the bottles, and as they are filled, immediately cork them well up, and fasten the corks with packthread or wire. Then spread a little straw on the bottom of a boiler, on which place the bottles, with straw between them, until the boiler contains a sufficient quantity. Fill it up with cold water; heat the water, and as soon as it begins to boil, draw the fire, and let the whole cool gradually. When quite cold, take out the bottles, and pack them with straw or saw-dust in hampers, and stow them in the coolest part of the ship, or in a cool place. Some years since, there was a Swedish or Danish vessel at Liverpool, having milk on board preserved in this manner; it had been carried twice to the West Indies and back to Denmark, and had been above eighteen months in the bottles; nevertheless, it was as sweet as when first taken from the cow.—*New Monthly Mag.*

Preservation of Cauliflowers.—These vegetables have been preserved for two or three months by digging a trench under a wall, eighteen inches wide and deep, laying in the cauliflowers with the stems inclined upwards, and covering the whole in with earth, heaping up the surface in an inclined form, so that the rain should run off.

Use of Larch Bark in Tanning.—Mr. E. Smith, from repeated trials made by himself and friends, strongly recommends the use of larch bark in tanning, not only for light calf, deer, or sheep's skins, but for stout hides; and states, that sole-leather tanned with it, and worn against other leather tanned with vallonia, resisted the wear better, and did not imbibe so much water. He then asks whether there is any further occasion for the importation of Dutch or German bark.—*Journ. of Science.*

Preservation of Fresco Painting.—A new process for removing frescoes from one wall to another without injury to the painting, has been devised by Signor Steffano Barezzi, of Milan. The picture is covered with a prepared canvass to which it adheres, and is thus detached from the wall. The canvass is afterwards applied to another wall, to which the painting again attaches itself without the least trait being destroyed. The practicability of this method has been successfully proved, and the inventor is now employed in transferring a large fresco from the church Della Pace, at Rome. Great expectations are entertained that he will be able thus to rescue from destruction the celebrated Cena of Leonardo da Vinci.—*Mag. of Fine Arts*, 474.

Green Paint.—Gas tar, mixed with yellow ochre, makes an excellent green paint, very useful for preserving coarse wood work or other articles.—*Journ. of Science.*

Economics.—In pulling down lately the vestry wall of a chapel, near the Lago Maggiore, which had been built more than 300 years ago, as appears by good documents, there was discovered, imbedded in the mortar of the wall, three eggs, which were found to be fresh. M. Cadet, after relating this fact, states that naturalists bring from America and India birds'-eggs, covered with a film of wax, which, after removing the wax with alcohol, may be hatched. He then talks of a man who sold eggs at the public market in Paris, which had been preserved upwards of a year in a peculiar composition. A slight layer of carbonate of lime observed on these eggs induced M. Cadet to suspect that lime-water was the preservative composition. He afterwards made experiments on this point,

under direction of the Council of Salubrity of Paris, and succeeded in keeping eggs perfectly sound during nine months and ten days, the period of the experiments. We believe this means of preserving eggs has been long known to housekeepers in this country, but it is less practised than it deserves to be. If every farmer would cause the eggs of his poultry to be put into a cask of lime-water the moment they were laid, the inhabitants of London might enjoy better breakfasts than they do at present.—*Journal of Science.*

THE WHOLE SCIENCE OF PHRENOLOGY.

WITHOUT either professing or denying our belief in this system of the human mind, founded on the developement of certain organs which Phrenologists affirm they have discovered in the brain, we shall proceed to give a short account of their situations and functions, either for the amusement or the instruction of our readers, but chiefly with a view of making them somewhat acquainted with a science, which at present occupies the public attention, and of putting it in their power to make observations for themselves.

PROPENSITIES.

1. AMATIVENESS. — *Situation.* The cerebellum is the organ of this propensity; it is situated between the mastoid process on each side, and the projecting point in the middle of the transverse ridge of the occipital bone; *i. e.* at the back of the neck, or lower part of the head. The size is indicated by the thickness of the neck at these parts. *Function.* The sexual passions. Venery.

2. PHILOPROGENITIVENESS. — *Situation.* Above the middle part of the cerebellum, corresponding to the general protuberance of the occiput; it is above Amativeness. *Function.* The instinctive love of offspring in general. Parental affection.

3. CONCENTRATIVENESS.—*Situation.* Above Philoprogenitiveness, and below Self-Esteem. *Function.* The faculty of concentrating several powers to one object. Study.

4. ADHESIVENESS. — *Situation.* On each side of Concentrativeness, above Philoprogenitiveness, and just above the lambdoidal suture. *Function.* The instinctive tendency to attach ourselves to others, to animals, or to objects. Friendship.

5. COMBATIVENESS.—*Situation.* At the inferior and mastoid angle of the parietal bone, behind the ear, next to Philoprogenitiveness and Adhesiveness. *Function.* Courage and the propensity to attack. Quarrelsomeness.

6. DESTRUCTIVENESS. — *Situation.* — Above the ear, corresponding to the squamous plate of the temporal bone, below Secretiveness, and next to Combativeness. *Function.* Desire to destroy in general. Murder.

7. CONSTRUCTIVENESS.—*Situation.*— At that part of the frontal bone, above the spheno-temporal suture, next Acquisitiveness, about 1½ inch from the eye, and nearly in a line with Destructiveness. *Function.* The tendency to construct in general. Mechanical skill.

8. ACQUISITIVENESS.—*Situation.* At the anterior inferior angle of the parietal bone, between Constructiveness and Secretiveness. *Function.* Desire to possess in general. Avarice, theft.

9. SECRETIVENESS. — *Situation.* At the inferior edge of the parietal bones, above Destructiveness, or in the middle of the lateral portion of the brain. *Function.* Tendency to conceal. Cunning, deceit.

SENTIMENTS.

10. SELF-ESTEEM. — *Situation.* At the top of the head above the posterior, or sagittal angle of the parietal bones, above Concentrativeness. *Function.* Self-love in general. Dignity, conceit, pride, selfishness.

11. LOVE OF APPROBATION. *Situation.* — On each side of Self-Esteem, about half an inch from the lambdoidal suture. *Function.* Love of other's esteem, and the expression of it in praise. Bashfulness, fame.

12. CAUTIOUSNESS.—*Situation.* Near the middle of the parietal bone, where ossification generally begins, between love of Approbation and Secretiveness. *Function.* The emotion of fear in general. Care, deliberation, doubt, panic.

13. BENEVOLENCE. — *Situation.* At the upper part of the frontal bone, in the coronal aspect, before the fontanel, above the brow, next Veneration. *Function.* Desire of the happiness of others. Philanthropy, hospitality.

14. VENERATION. — *Situation.* At

the middle of the coronal aspect, at the bregma, or fontanel, between Benevolence and Firmness. *Function*. The sentiments of respect, reverence, and adoration. Religion, idolatry, toryism.

15. HOPE.—*Situation*. On each side of Veneration, under part of the frontal, and part of the parietal bones. *Function*. Tendency to believe in the possibility of attaining our desires. Belief, credulity.

16. IDEALITY.—*Situation*. Along the lower edge of the temporal ridge of the frontal bone, above Acquisitiveness. *Function*. The feeling of exquisiteness and perfectibility. Sensations of sublime and beautiful. Fine Arts. Enthusiasm.

WONDER.—*Situation*. Above Ideality. *Function*. Sensations of novelty, surprise, astonishment. News, mystery, supernatural agency.

17. CONSCIENTIOUSNESS.—*Situation*. On the posterior and lateral parts of the coronal surface of the brain, above Cautiousness, behind Hope. *Function*. Feelings of right and wrong. Justice. Duty.

18. FIRMNESS.—*Situation*. At the posterior part of the coronal surface of the head, close upon the middle line, between Self-Esteem and Veneration. *Function*. To produce determination, constancy, perseverance, and fortitude. Decision of character, obstinacy, stubbornness, infatuation.

INTELLECT.

19. INDIVIDUALITY.—*Situation*. In the middle of the lower part of the forehead, or brow, below Comparison, Nos. 1 and 2. *Function*. The desire and ability to know facts and things. Philosophy, science, metaphor.

20. FORM.—*Situation*. Between the eyes; the degrees of this organ correspond to the greater or less developement of brain, situate on the mesial, or inner side of the orbitary plates of the frontal bone, on each side of the *crista galli*. *Function*. To judge of form, to distinguish faces. Imitative arts.

21. SIZE.—*Situation*. Above the eyes; below Locality. *Function*. Facility in estimating size. Perspective.

22. WEIGHT OR RESISTANCE. *Situation*.—Above the eyes; next Size. *Function*. To judge of the weight, resistance, or momentum of bodies. Laws of Mechanics.

23. COLOURING.—*Situation*. Above the eyes; next Weight. *Function*. To perceive colours. Painting, dyeing, &c.

24. LOCALITY.—*Situation*. Above Size and Weight. *Function*. Local memory. Desire for travelling. Topography, geography, astronomy, landscape, painting, &c.

25. ORDER.—*Situation*. Above the eyes; between Colouring and Number. *Function*. Love of order and arrangement. Desire to see every thing in its place.

26. TIME.—*Situation*. Above Colouring and Locality. *Function*. Recollection of dates, judging of time and of intervals in general. Chronology, association.

27. NUMBER.—*Situation*. The arch of the eye-brow is either much pressed downward, or there is an elevation at the external angle of the orbit, next Order. *Function*. The conception of number and its relations. Arithmetic, algebra, logarithms.

28. TUNE.—*Situation*. In the lateral part of the forehead, between Constructiveness and Wit. *Function*. The perception of melody. Taste for music.

29. LANGUAGE.—*Situation*. In the eyes. *Function*. Faculty of acquiring the knowledge and the use of language. Style, volubility, verbal memory.

30. COMPARISON.—*Situation*. In the upper and middle portion of the frontal bone, between Benevolence and Individuality. *Function*. Power of perceiving resemblances, similitudes, analogies, and coincidences. Reasoning by comparison, proverbs, parables.

31. CAUSALITY.—*Situation*. In the upper part of the frontal bone, on each side of Comparison. *Function*. Desire to discover causes and their connection with effects. Deep penetration, genius for metaphysics, political economy, and similar sciences. Speculation, abstraction.

32. WIT.—*Situation*. In the anterior-superior-lateral parts of the forehead, between Causality and Tune. *Function*. Disposition to view objects in a ludicrous light. Humour, joke, satire, epigrams.

33. IMITATION.—*Situation*. In the superior-anterior portion of the head, on the two sides of Benevolence, rising up in the form of a segment of a circle. *Function*. The power of imitation in general. Found in artists, players, painters, sculptors, engravers, &c.

The general developement of each of these 34 organs, now described, is, by a protuberance, or prominence in that part

of the head where it is situated, and the relative proportion which that protuberance, or prominence, bears to the rest of the skull, and the adjoining organs. When the organs are immoderately large, it leads to their abuse, according to Phrenologists.

The map of the head, containing the situations of the organs, as denoted by the number of each in this article, will be given in our next, as it could not be got ready this week.

MISCELLANEOUS NOTICES.

ORACLE OF THE ARTS.*

THIS compilation, though in a small and cheap form, contains a great deal of very curious and useful information. In it will be found a great number of the most remarkable experiments, published in larger and far more expensive works, under the title of Philosophical Recreations. Such a work, therefore, cannot fail to be acceptable to the young Mechanic, in leading his mind to the study of the Sciences, from their manifest utility and adaptation to produce rational amusement. Though Science to some appears most attractive in her native purity, yet to others the extrinsic charms of a gay and alluring dress, seems necessary to draw their attention to her wonder working powers. A small work like this, which professes to initiate the young into the mysteries of art, as founded on Science, will form a first desideratum to them; and, by it, they may be led to the study of those higher, and more important works, which confer renown on their authors, from the discoveries which they contain, and honour on the species, from the achievements of intellect which they display. We have not room for an extract this week.

* Bumpus, London; Griffin, Glasgow. —1824.

GLASGOW OBSERVATORY.

THIS Institution, which has been long in a lingering state, is, we are happy to learn, about to be re-established on a plan more useful to the Public, than that which has hitherto regulated its management. Subscriptions have been going on for some time for this purpose, and they are at present in considerable advance, though there be still a deficiency to render the Institution independent of the incumberances which have till now hung over it, and make it more secure from such in future. We trust that, for the honour of our native city, and the scientific character of its 150,000 inhabitants, which is at stake, that the remaining sum will immediately be subscribed, and that the portals of the sublimest of the Sciences may be thrown open to the poorest individuals.

NOTICES TO CORRESPONDENTS.

T., J. M'L. or a Country Mechanic, Rusticus, and P., will be inserted.—Mr. Ballantyne's Life Boat and Mr. Vallance's Boat with Wings, with other curious matter, are intended for next week.—U. S. C., the Inventor of the Sea Chart, is requested to call upon us as soon as he conveniently can.—L. M'L.'s piscatorial effusion really won't do.—R. M., Arithmeticus, and A Man of Genius, under consideration.

We beg to inform J. G. that a certain Ex-editor and printer of a small thing published in Glasgow, long ago *defunct*, 'yclept, the *Literary Reporter*, is "strongly suspected" to be the author of the "helpless" tirade against us, for our animadversions on the conduct of some individuals connected with the Glasgow Mechanics' Institution; and that we are obliged to him for his good intentions, yet it is unnecessary to notice such a puny concern, especially as the individuals at the helm of affairs in that Institution disclaimed all connection with the author, and have expressed their regret at the appearance of his mountain-in-labour production.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, and Original Patents, Inventions, &c. will be inserted on the shortest notice.

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THE GLASGOW
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"Happy is he who can discover the causes of things."—*Cicero.*

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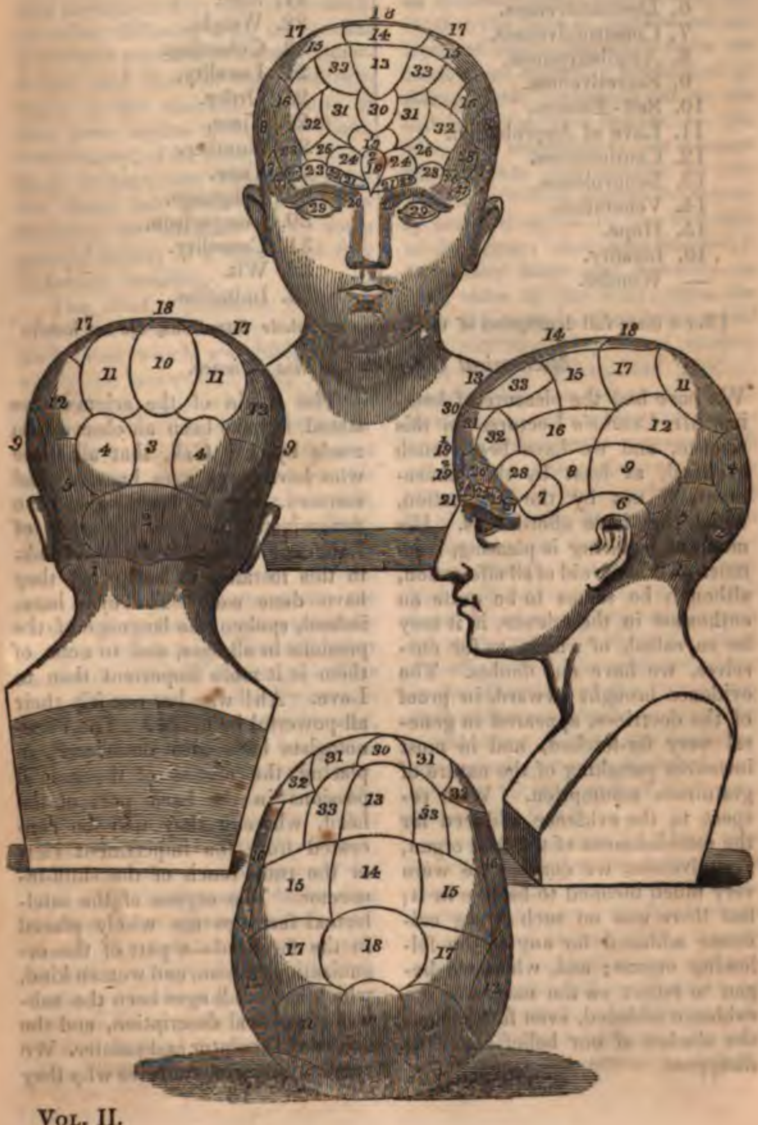
THE PHRENOLOGICAL ORGANS.



ON THE SCIENCE OF PHRENOLOGY.

Description of the Engraving.

No. 1. Amativeness.
2. Philoprogenitiveness.
3. Concentrativeness.
4. Adhesiveness.
5. Combativeness.
6. Destructiveness.
7. Constructiveness.
8. Acquisitiveness.
9. Secretiveness.
10. Self-Esteem.
11. Love of Approbation.
12. Cautiousness.
13. Benevolence.
14. Veneration.
15. Hope.
16. Ideality.
— Wonder.

No. 17. Conscientiousness.
18. Firmness.
$\overset{1}{19}$. $\overset{2}{19}$. Individuality.
20. Form.
21. Size.
22. Weight.
23. Colouring.
24. Locality.
25. Order.
26. Time.
27. Number.
28. Tune.
29. Language.
30. Comparison.
31. Causality.
32. Wit.
33. Imitation.

[For a more full description of the Organs and their Situations, see our last.]

Mechanical Objections to this Science.

WE have had the pleasure of hearing Mr. Combe's Lectures on this science, and we have been much gratified, at least by the amusement, if not by the instruction, which they have afforded us. His mode of lecturing is pleasing, inasmuch as it is devoid of all affectation, although he seems to be quite an enthusiast in the science, if it may be so called, of which, as for ourselves, we have our doubts. The evidence brought forward, in proof of the doctrines, appeared in general very far-fetched, and in most instances partaking of the nature of gratuitous assumption. With respect to the evidence adduced for the establishment of the first organ, Amativeness, we confess we were very much inclined to believe in it; but there was no such strong evidence adduced for any of the following organs; and, when we began to reflect on the nature of the evidence adduced, even for the first, the shadow of our belief began to disappear.

The origin of the science was stated to have been an observation made by Dr. Gall, that all those who have large eyes have a good memory. Hence Phrenologists have denominated the eyes the organ of Language, and certainly, we think, in this instance at least, that they have done well. The eyes have, indeed, spoken the language of the passions in all ages, and to none of them is it more important than to Love. Ah! who has not felt their all-powerful influence? The Phrenologists have also done well, in placing the organs of the animal passions in the back part of the head, whereby they may be concealed from the impertinent view or the rude touch of the skull-inspector. The organs of the intellectual faculties are wisely placed in the forehead—a part of the organization of man, and woman kind, which has in all ages been the subject of poetical description, and the arts of the sculptor and painter. We cannot, however, conceive why they

have placed so many organs, of no small importance, immediately above the eyes, and allotted such diminutive portions of the brain to some of the most useful and necessary faculties, while they have given others, of far less utility and activity in the human system, such large and prominent situations in the skull. Another difficulty with us is, that particular portions of human knowledge, and those of the least moment in the common business of life, have organs allotted to them, while many, of far more importance, have no particular organs set apart for them, but are either entirely omitted, or included under some general faculty of a vague and very indefinite meaning.

The chief objections, however, which we mean to state at present, and those which we think cannot easily be answered, refer to the natural language of the different organs, or of the faculties which they indicate. Mr. Combe stated, as a general law, that the head was always thrown backwards or forwards, upwards or obliquely, in the direction of the particular organ which was in immediate action. He also stated that individuals, under the action of the same organ, generally inclined their heads to each other in the direction of that organ. This natural language of the organs was exemplified in Philoprogenitiveness, by throwing the head back in a straight line, and the chin, of course, forward in the direction of the object exciting its action; in Adhesiveness, by inclining the head back, and to one side or other towards its object; in Cautiousness, by moving the head from side to side in a horizontal position, and consequently by rolling the eye about in all directions, or by viewing the object in a variety of ways; in Veneration, by raising the head generally; or, if the object is before us, by lowering it; in Firmness, by a proud erect position, corresponding to the situation of the organ in the top of the head; and so of the rest.

Now, the most striking objection, especially with reference to the double organs, *i. e.* those situated on each side of the head, such as Adhesiveness, Cautiousness, &c. is, that the laws of mechanical action, (of which this is said to be the result,) are evidently overlooked or disregarded; because, (and we are indebted for the remark to Dr. Ure, who suggested it the moment the sentence was uttered by Mr. Combe,) if "these organs instinctively produce action in the direction of the organ;" and if, as asserted, it is equally large and powerful on both sides of the head; then, the plain inference is, that being equal and contrary, they must destroy each other's effects, and produce no natural action or language at all, in all those cases where the organs are situated directly opposite each other; and where they are not so situated, they must produce action or motion in the directions, neither of the one nor the other, but between them, and different from both. If such organs, on the other hand, were more large and powerful on the one side than the other, the effect would be produced either in the direction of the larger one, or in a line more inclined to it than to the other, so that the double or reciprocating motion is absurd, and contrary to the result of their premises.—Q. E. D.

Another objection is, that if two individuals, under the influence of the same organ towards each other, incline that part of the head where it is situated to each other, then in many cases a most absurd and unnatural position of both would be the consequence. Mr. Combe exemplified Benevolence, by the case of two children under its feeling,

inclining their foreheads to each other. Now, if this were uniformly the case, then if they were under the influence of Adhesiveness, (which by the bye is more likely than the former,) then they would turn the back part of their heads to each other, and their faces would be turned completely away from one another. This would be totally a different mode of expressing that beautiful feeling, which, in the words of an ancient writer is thus beautifully delineated: "he fell on his neck and kissed him; and they wept together." Were the natural language of the organs of Combativeness and Destructiveness in like manner to be expressed according to this theory, we would see men and women knocking their heads like rams against each other; and, in short, the language of all the other organs would be equally ridiculous and absurd.—Q. E. D.

We might speculate at greater length upon this and other subjects connected with this science, and might draw a host of corollaries, which would go near to annihilate the system on *mechanical principles*, but we forbear, lest our readers should consider that we had engaged in a work of supererogation.—We, therefore, leave them to draw their own conclusions, having done our duty in so far laying the subject before them.

ON THE CULTURE AND MANUFACTURE OF INDIGO IN THE PROVINCE OF BENGAL.

(For the Glasgow Mechanics' Magazine.)

(Concluded from page 217, Vol. II.)

5th. *On the Beating.*

To work a vat well and quick, as it ought to be done, 12 coolies or labourers are required; of these (as soon as all the liquor has run off from the steeper,) 10 go into the beater, with small paddles, about 4 feet long, (resembling those used by the American Indians to pull their canoes,) to agitate and beat the water, which they do by walking backwards and forwards in the vat, beating the water, as if they were pulling a canoe. The two remaining coolies are employed in opening the beams and bamboos from the steeper, and throwing away the plant which has now become useless, except for firewood, and in getting the vat cleaned to be ready for a fresh supply of plant. On first going into the vat, the coolies ought to beat strong and regular, and to keep the liquor in constant motion. After the beating has continued about $1\frac{1}{2}$ hours, the grain begins to separate; this is the time to judge if there has been any defect in the fermentation, and the degree of beating must be regulated accordingly. A vat that is deficient, generally froths much in the beating, but a spoonful of oil thrown in, immediately makes the froth disappear, and as the beating goes on, the water becomes of a reddish colour. When the grain has grown large and round, the beating must be côntinued, carefully observing its diminution; when it becomes like very fine sand, and the water clear, it may be left to settle.

A vat that has been over-fermented, is generally attended with a thick greasy frothing scum, which will not disperse, should a bottle of oil be used. In this case, the degree of beating must be diminished, and when the grain becomes round, it will settle, and leave the water clear, when the beating should be stopped. The froth that hung about the corners, then spreads itself in small lumps over the whole surface, and appears not unlike frogs floating

on the top of the water. This is a certain sign that the plant has been too much fermented. A vat that has had its proper degree of fermentation is not difficult to beat, it commonly froths a good deal, but immediately after the grain begins to form, it begins to disappear—and afterwards, when the vat is finished, disappears altogether. The liquid, on first being let off, is of a light greenish colour, but by the time the grain is become large and round, the water grows of the colour of Madeira; after beating a little more, a clean round grain is formed, which will settle clear from the water, and have neither scum nor cloudiness, and the fecula from vats of this description, may be depended upon as good Indigo.

6th. Draining the Vats.

In the front wall of the beater, or lowest vat, there is a piece of incorruptible wood, or where stone can be found, pieces of it, about 2½ feet long, and 12 inches broad, built in with the mason work. Into this, small holes, varying from 3 to 4 inches in diameter, and at various heights, are bored through the wood to form scuppers, and are, during the process of beating, shut up by round plugs made to fit them; they serve to drain off the water which swims on the fecula or sediment. After the beating process is finished, in about 2 or 3 hours, in a tolerably calm day, every particle of the Indigo or fecula, will have precipitated itself to the bottom of the vat. The water must then be let off, by taking out the plug from the upper hole, which, being set in the wall, about 18 inches above the floor, the Indigo will have settled below it. When no more water will run from that spout, the plug must be withdrawn from the one underneath it, and so on, till all the water be drawn off. The *quality of the water*, when let off, should be examined, to form a judgment of any error that may have happened in the process, that it may be rectified in the next vat; for good Indigo never produces a foul, cloudy water, and if that be the case, there must be some defect either in the fermenting or beating.

When the water is of a high reddish colour, like old brandy, but clear, and free of any particles of the grain floating on it, the fermentation has been rather short of its proper degree, but the beating well conducted. The Indigo will be of a good quality, but the produce not so much as it ought to have been. But when this reddish water appears cloudy, and on examination there is found a kind of volatile flattish grain floating in it, and accompanied with a thin copperish scum, it is deficient both in fermentation and beating. The Indigo will be of an excellent colour, but will crack and break much in the drying, not having undergone a sufficient process to acquire the necessary cohesion. When the water is of a lively greenish colour, with the grains floating in it, the beating has not been continued long enough; but, when the water is of a dirty green, accompanied with a bluish tinge, there has been an excess of both. The excess of fermentation not admitting of a sufficient degree of beating to clarify the water, makes it of that dark green colour, the blue tinge being part of the grain broken, by the beating being carried higher than it would bear. Great attention should be paid to know where the error lies, that it may be rectified in the next day's work. When the plant is good, and both fermentation and beating properly conducted, the water runs off clear and transparent, and mostly of the colour of Madeira, the essence of the plant has been extracted, and the Indigo will be of a good quality.

7th. *Of the Boiling, Pressing, and Drying.*

When all the water has been drained off, and nothing but fecula remains, a person is sent into the vat to gather it all into one corner, where there is a small hollow, sufficiently large to allow an earthen pot to be dipt in to lift the fecula from the vat into a drain, running along the surface of the front wall of the beater; this drain conveys it to the receiver, which is a small vat, built near the boiler, about 20 feet long, and from 3 to 4 feet deep and broad; from this place, when all the fecula of the other vats is gathered together, it is pumped up into the boiler; a strainer of coarse open cloth is held at the mouth of the pump, to prevent any leaves or other dirt which may have fallen into the beater, when passing through. A fire is immediately lighted, and the liquor left to boil until all the froth is consumed, and the fluid assumes the appearance of oil. When it has attained this point, which it will do in 3 or 4 hours, if a good fire is kept up, it is let off into the table, which is a large square frame of wood, (for a factory of 12 pair of vats), 20 feet long, 10 feet broad, and 3 feet high, across which a grating is placed, two feet from the top, leaving an open space of 400 square feet, which ought to be the contents of the boiler. This table is placed inside of a brick cistern made to fit, having a slope from all its sides to one corner, at which there is an opening, with a small receiver, built in the ground outside. Inside of the table, a strong thick sheet of cotton cloth made to fit exactly, is placed and wetted a little. This is meant to arrest the solid part of the fecula, the more liquid runs through into the brick cistern, and from thence, (on account of the sloping bottom,) to the small receiver outside; from which it is pumped up by a small hand pump, into the table again, and thus carried on till nothing but clear water runs off. It is then left to allow the water to drain off, and another sheet is thrown over the table, to prevent any dust or dirt falling in. On removing this sheet, the following morning, a quantity of fecula, resembling blue slime, is observed on the former sheet, which, being all gathered up in it to one corner of the table, is from thence lifted up by wooden spoons into the press chests; into these, a damp cloth bag made to fit is put, to prevent it running through the holes in the sides and bottoms, which were made to allow the water to pass through during the pressing. The bottom and sides are fastened together by iron hooks, so as to allow the chest to be taken to pieces at pleasure.

When the chest is filled, (which is about 30 inches square, and eight inches deep,) the ends of the bag should be doubled over it, and the cover put on; this is made to fit to the inside of the chest, to press the whole down even. The chest is then set on the press-stand, a machine exactly similar to that used for packing stockings, but, of course, much larger and stronger. This varies, however, in different factories, some using two, and others three screws. Every three or four minutes, the screw should be turned once round, with a strong regular pull; after which the pressing will be finished in about three hours. The press is then opened, the chest taken out, the cover removed, and the sides taken away from the bottom, by opening the hooks which keep them together. The doubles of the linen bag being then carefully removed and folded down, you have there before you a large, solid, even cake of the same size as the chest, but now reduced to three inches in thickness, which is cut into small squares of three inches each way.

y are then put upon little boards, carried to the drying house, and there on stages to dry. Nothing her is necessary, but to turn the s every two or three days, till become dry and hard, which will be in the course of three ths, when they may be taken the stages. The moulding h may have gathered on them usted off, and the cakes put in lar layers in the chests for exation.

om what has been said, we may lude that Indigo, whatever me- is taken to make it, is nothing than a sediment got from the of that name, by means of wa- and precipitated by frequently ng it. What is more surprising hat although Indigo has been made for such a length of time, no person has yet found out the secret of manufacturing it so as to be certain of having it of the best quality. The most skilful artists mistake; sometimes because they have made the plant ferment too much, or too little; sometimes because they have over-agitated the water in the second vat, or perhaps not enough. In the first case, the grain of the Indigo already formed, dissolves again. In the second, the grain which was not entirely formed, remains floating in the water, instead of precipitating to the bottom of the vat, and is consequently left when the water is drawn off.

R. M. Hastie.

Jorada Factory, Jessore, Bengal, 1st March, 1824.

SKETCH OF THE HISTORY OF PHILOSOPHY,

Particularly with reference to Mathematical and Mechanical Science.

(Continued from page 198, Vol. II.)

following observations will to give our readers an idea of ncient method of Exhaustions. res that are bounded by straight are compared with one ano- by supposing the one placed the other, and if they coin- in all respects, they are then ntly to be considered as simi- id equal. This is the funda- al principle of Elementary Geo- r, and a very simple one it is. e help of this principle chiefly, other considerations, the first ropositions of Euclid's elements emonstrated. The principle is lown in the 4th Proposition, it is shown, that two triangles qual, if, when the one is super- d (placed) on the other, (the ides and the included angle equal,) it is thence inferred heir bases and areas are equal. hen extended in the 35th Pro- on, to the case of two parallelograms, (having equal bases and altitudes,) which are shown to be equal; because the same triangle taken from one of the parallelograms on the one side, and added to it on the other, converts it into the other parallelogram; and thus two magnitudes, which are not similar, are shown to have equal areas. In the same way, when a triangle and a parallelogram, having the same base and altitude, are compared, it is easily shown that the triangle is the half of the parallelogram; because, if to the given triangle there be added another, similar and equal, but in the reverse position, they will constitute a parallelogram, having the same base and altitude with the given triangle. This Proposition, simple as it appears to be, furnishes us with the means of measuring areas and fields, and is consequently the fundamental principle of two very useful branches of Prac-

tical Mathematics, Mensuration, and Land-Surveying. The same reasoning may be applied to all other figures, bounded by straight lines, as they can always be ultimately resolved into triangles.

This principle, however, general as it is, is not universal; it will not apply to figures bounded by curve lines; rectilineal figures, or those that are bounded by straight lines, can never be compared with curvilineal figures, or those that are bounded by curve lines. Apply them, or place them above each other in any manner you please, they will never exactly coincide. Here, the Geometer is obliged to stop, till the light breaks in upon him; by continuing his investigations, he will find that this will ultimately be the case, wherever a possibility exists. To search, where it can be demonstrated not to exist, would argue a want of the true spirit of science; a misfortune that has generally befallen those who have neglected the study of rigid demonstration. To some fortunate genius, however, the happy thought occurred, that by making a rectilineal figure within a curvilineal one, and another rectilineal figure without it, two limits would be found, the one greater, and the other less than the area of the curvilinear figure. By increasing the number of the sides of those rectilineal figures, the lengths of the sides would be diminished, and the two limits would be brought continually nearer to each other, and, consequently, nearer to the curvilineal figure which was always intermediate between them.

The result of this approximating mode in those cases where it succeeded, must have given to the mind of the original discoverer both surprise and delight. He found, that, when the series of figures constructed within the curvilineal one, *was continually increased* by the above method, there was a certain *known* or *determinable* area, to which each successive figure always approached, so as to come nearer to it than any given space, however small. He found also, that the same thing occurred with the figures constructed *about* the curvilineal one, and, therefore, he justly inferred that the *certain known* or *determinable* area, could be no other than that of the curvilineal figure.

By this means, Archimedes first discovered that two-thirds of the area of the rectangle contained by the ordinate and the absciss of a parabola, was a limit of this kind, and was consequently the area of that figure. He also showed, by the same mode, that the area of the circle was equal to the rectangle contained by the radius and the semi-circumference.

This ingenious and rigid mode of demonstration laboured under two great defects, from which it was impossible to free it, and therefore a new analysis became necessary. The demonstrations themselves were generally long and difficult, and they furnished no clue to a mode of discovering Geometrical truths. The method of Exhaustions required, that the truth of the proposition to be demonstrated, should be previously ascertained, either by a sagacious guess, or by mechanical trials. Thus, if a mechanic were to construct an accurate parabola on a piece of paper, and describe a parallelogram, whose base should be one of its ordinates, and having the same altitude, he might discover its area by the following means: Let him cut the whole parallelogram out of the paper, and weigh it; then let him cut out the parabola from the parallelogram, and weigh it separately, and he would find, if the operations had been acurately performed, that the weight of the parabola was exactly two-thirds of the

weight of the parallelogram; hence he might infer that their areas were in the same proportion; but how is he to be assured of the absolute fact? only by demonstration. It was in this way, very probably, that Archimedes first discovered the beautiful relations of the Cylinder, and its inscribed Cone and Sphere, viz. *by mechanical construction;* he made them; he weighed them; he discovered their proportions; and he then demonstrated their truth by the refined method of Exhaustions.

Milan, and the year 1598, were celebrated for the birth of Cavalieri, the author of one of the great improvements which was to supersede the method of the ancients. His principle was simply this: He conceived that areas were made up of an infinite number of parallel lines; that solids were made up of an infinite number of parallel planes; and that even lines themselves were made up of an infinite number of points. The finding of the area of a curvilineal figure, was, by this principle, reduced to the finding the sum of a series of ordinates; and that of the content of a solid, to the finding the sum of a series of planes, parallel to one another, and parallel to the base of the solid. This process, though a departure from the strict reasoning of the ancients, was comparatively easy, and though even objectionable in many points, led to the discovery of new geometrical truths. It is worthy of remark, that Cavalieri took the idea of his method from the great Astronomer Kepler, who had been occupied with the investigation of the solids corresponding to the figures of casks and other vessels for liquids. This eminent man had the sagacity first to introduce into Geometry the bold idea of infinitely great and infinitely small quantities, and by this departure from the strictness which had hitherto surrounded that science, rendered it an important service. He supposed a circle to be composed of an infinite number of triangles, having the vertex of each in its centre, and their bases, which were infinitely small, were in its circumference. Galileo, another able Astronomer, had introduced similar ideas in his work on Mechanics. Cavalieri, however, had the merit of forming the idea into a system, which was published in 1635, and was denominated the *method of Indivisibles.* This method was improved and extended by other mathematicians. Roberval and Torricelli applied it successfully to the quadrature of the Cycloid. The properties of this, and other curves, required a still farther extension of the powers of calculation, and this was furnished by modern algebra.

(To be continued.)

ON Mr. MACKINNON'S MACHINE FOR MAKING SCREWS.

Sir,—I shall feel happy, if, through the medium of your valuable Magazine, I shall be able to make my description of the Screw-making Machine more intelligible to your Correspondent, "A Plain Mechanic." He says he cannot discover "the relation that subsists, &c."

It is from this circumstance (that *no relation subsists, &c.*) that the truth of the screw depends. If there was any machinery to guide the cutter, then the truth of the screw would depend wholly upon the accuracy of such machinery.—In my machine, the truth of the screw depends upon the accuracy of the cylinder to be screwed; and upon the accuracy of the bar upon which the cutter-frame rolls; for it is evident, if the edges of the bar

are not parallel, that the cutter-frame will be obstructed in its motion, and, consequently, the screw will be destroyed. To obtain a perfect screw, the bar to be screwed must be *a cylinder*, and well polished, so as to have no scratches to lead the cutter astray. To obtain a given number of threads in an inch, &c. I cannot give a practical rule; for it is evident the cutter remaining at the same angle, will cut cylinders of different diameters with a very different pitch of thread; for a cylinder half an inch in diameter, will have twice as many threads in the same space, as one that is one inch in diameter.

I am, SIR, your's, &c.

Angus Mackinnon.

Sheffield, 11th October, 1824.

IMPROVEMENT ON MR. MURRAY'S MODE OF FORMING COMMUNICATIONS WITH THE SHORE IN SHIPWRECK, &c.

MR. EDITOR,—I observe an article by a Mr. Murray, in the 23d Number of the last volume of your Magazine, "On forming a communication with the shore in shipwrecks," &c., by shooting from a musket an arrow with a line attached to it.

It appears from Mr. Murray's experiments, that the line always snaps, if introduced into the musket; and, therefore, instead of the lower end, he had fastened it to the point of the arrow projecting from the musket. But when the discharge is made, it is evident that the weight of the line, always increasing the farther the arrow flies, will soon weigh down its point, and prevent it from going so far, or so straight, as it might have done, had the line been attached to the after-end. Likewise, in harpooning whales with it, (as I understand several vessels have been trying this season,) the line will enter the fish along with the harpoon, and when any tug or stress comes upon it will be apt to wrench out the instrument altogether, and thus cause the entire loss of the fish.

There is a method, however, which does away with the necessity either of fixing the line to the point, or introducing it into the barrel of the musket, by fixing it to the bottom of the arrow. This is effected by a ring, made so as to run easily from one end to another upon the shaft of the arrow, but prevented from coming off by the barb at the head, and a small shoulder at the other end. When the musket is charged with powder, the ring with the line fastened to it, is run up to the head of the arrow, and the shaft put into the barrel of the musket. At the moment of the discharge, the arrow flies through the ring, till it comes to the shoulder which carries ring, rope, and all along with it.

If the ring will not slide properly upon the shaft, in consequence of the rope being fastened only to one side of the ring, then the rope may be split and fixed to both sides.

W. B.

Glasgow, 25th October, 1824.

DISPUTED INVENTION.

MR. EDITOR,—I observe in the XLIst Number of your valuable Magazine, page 181, vol. II, a communication from Peter Fenwick, watch *and clock-maker,* Crieff, in which he claims the priority of the invention of the method of causing the driven and driving wheel in machinery to revolve the same way; and in which he states, that in the year 1823, he

had hit on the same mode of producing this effect, that is exemplified in the three-wheeled clock I sent you, and which you published in your XXIVth Number.

It has been remarked, and with truth, that two or more different persons, in places distant from each other, and at different periods, may, and often have hit upon the same invention, unknown to each other, and this seems to be the case with Mr. Fenwick and me. I have to state, that the method of causing all the wheels in a clock, or other wheels working in each other, to revolve the same way, without intermediate aid, by means of cutting the teeth in the inside of the rim, was familiar to me fifteen years ago; and about that period I constructed the simple machine of a fishing pirn for a gentleman upon that plan, which completely answered the desired end, and to which I referred in my former communication. This happened about 14 or 15 years before Mr. Fenwick did himself the honour of presenting his model to the Society of Arts; but I never thought of arrogating to myself any merit for the invention, as I thought it very probable that other mechanics, although unknown to me, might have adopted the same plan; and all the merit (if there is any in the case,) that I considered myself entitled to, was the application of this invention to clockwork, in such a simple manner as to produce the greatest quantity of Index movements, in one direction, with the smallest number of wheels. I hope you will favour me by inserting the above.

I remain, your's, respectfully,

William Cooper.

Hamilton, 25th October, 1824.

P. S.—I have no hesitation in attesting the truth of the above statement, having frequently conversed with Mr. Cooper on this subject at the period he mentions.

GAVIN BURNS,
Land-surveyor, Hamilton.

PRESENT WORTH AND DISCOUNT.

SIR,—Having observed in a late Number of your publication an easy method of calculating interest at 4 per cent., I take the liberty of communicating to you a method of calculating discount considerably more expeditious than the one which, if I mistake not, is in general use at present; which communication please to insert, if you think it deserving the notice of any portion of your readers, and in other respects a suitable one.

1. *General Rule for finding the present Worth.*

Multiply the given sum by 73000; multiply the number of days by double the rate per cent.; add the product to 73000, and divide the former product by the sum. The quotient is the present worth.

Examples.

What is the present worth of £358 " 6 " 8, due 67 days hence, at 3½ per cent.? and of £110 " 17 " 3½*d.*, due 113 days hence, at 5 per cent.?

```
              Here, £358⅓
                    3)73000
                    1074000
             73000  2506
  67 × 7 =     469     24333 " 6 " 8
             73469)26158333 " 6 " 8(£356 " 0 " 11 present worth.
                    220407
                     411763
                     367345
                      444183, &c.
```

Again, £110 ״ 17 ״ 3½ × 73000 = £8093114 ״ 11 ״ 8;
And, 73000 + (113 × 10) = 74130;

Therefore, $\frac{£8093114 ״ 11 ״ 8}{74130}$ = £109 ״ 3 ״ 5¾ Present worth.

2. *General Rule for finding the Discount.*

Multiply the given sum by the number of days, and by double of the rate per cent.; divide by the same divisor employed in finding the present worth; the quotient is the discount.

Examples.

Find the discount of the above sums, for their respective days, and at the same rates per cent.

```
              Here, £358⅓
                     3)67
                     ----
                     2506
                    2148
                        22 ״ 6 ״ 8
                    --------------
                    24008 ״ 6 ״ 8
           73000                 7
  67 × 7 =   469
           -----------------------
           73469)168058 ״ 6 ״ 8(£2 ״ 5 ״ 8¾ discount.
                 146938
                 ------
                  21120
                     20
                 ------
                 424406, &c.

              Again, £110 ״ 17 ״ 3½ × 3
                                  10
                     ----------------
                     1108 ״ 12 ״ 11
                                  11
                     ----------------
                    12195 ״  2 ״  1
                      332 ״ 11 ״ 10½
                    -----------------
             73000  12527 ״ 13 ״ 11½
113 × 10  =   1130                  10
           ---------------------------
           7413.0)12527.6 ״ 19 ״  7(£1 ״ 13 ״ 9¼ discount.
                  7413
                  -----
                  51146
                     20
                 -------
                 1022939, &c.
```

As these Rules are neither in Euler, nor in Bonnycastle, it may be proper to explain the reason of them. The present worth of a sum payable a certain number of days hence, is the sum which, along with its own interest for the number of days, will amount to that sum, and the discount is that interest. If, then, we denote the given sum by s, the number of days by n, and the rate per cent. by r, the present worth by p, and the discount by d; then, $p + d = s$; and d being the interest of p, by the rule in common use for calculating interest for days, $d = \frac{2\,r\,n\,p}{73000}$; therefore substituting this for d in the former equation, we have $p + \frac{2\,p\,n\,r}{73000} = s$; which equation being resolved, gives $p = \frac{73000\,s}{73000 + 2\,r\,n}$; hence this formula *expressed in words* gives the rule for the present worth.

Again, since $p + d = s$, then $d = s - p$, and substituting in this equation the value of p, from the above equation, gives $d = s - \frac{73,000\ s}{73000 + 2\ n\ r}$, which being simplified, gives $d = \frac{2\ n\ r\ s}{73000 + 2\ n\ r}$, which formula, expressed in words, gives the rule for the discount.

B. J.

VARIOUS COMMUNICATIONS.

CHINA ROSE.

SIR,—It is a curious fact, that a China rose, when budded upon the shoots of a sweetbrier, will grow a flower in winter, (if the weather is mild,) when the sweetbrier shows no signs of vegetation.

If the China rose were drawing nourishment from the roots, one would naturally expect the sweetbrier to push out shoots also, but this is not the case; this may be new to some of your readers, and, I hope, will draw from some of your learned Correspondents a reason to satisfy an inquiring mind.

M. A.

COMMON NETTLE.

SIR,—If any of your Correspondents could inform me, whether *lint* has ever been manufactured from the common *nettle*, and to what extent, or what objections have been urged against it, they would oblige,

M. A.

CURING INJURIES, &c. IN TREES.

SIR,—The account W. R. gives (vol. II. page 173) of curing injuries and defects in trees, is just the same, word for word, that Forsyth gives in his treatise on the culture and management of fruit trees, (see page 455, third edition.)

This composition, about which such a noise has been made, and to which some wonderful virtue has been attributed, does nothing more than exclude the air, sun, and wet, from the wound, which may be effected, after having the diseased parts cut off, by covering the wound with fresh cow dung, mixed with urine, to the consistency of thick paint, leaving the rest to nature. This, Forsyth, in effect, acknowledges, (see Postscript to Preface,) after having made such a blast about the extraordinary effects of his composition.

I am, SIR, your most obt. servant,

M. A.

METHOD OF FREEING APPLE TREES FROM MOSS.

THIS method consists in daubing over the trunk and all the large branches of the tree, when the sap begins to rise, with a a large brush dipped in whiting made of lime, pretty thick; the moss, and all the rotten bark will soon drop off, and be replaced by a new bark entirely smooth.

J. RANKINE.

ARTIFICAL MAHOGANY.

THE following method of giving any species of wood of a close grain, the appearance of mahogany, in texture, density, and polish, is said to be practised in France, with such success, that the best judges are incapable of distinguishing between the imitation and mahogany. The surface is first planed smooth, and the wood is then rubbed with a solution of nitrous acid. One ounce of dragon's blood, is dissolved in nearly a pint of spirit of wine, this and one-third of an ounce of carbonate of soda, are then to be mixed together and filtered, and the liquid in this thin state is to be laid on with a soft brush. This process is to be repeated, and in a short interval afterwards, the wood possesses the external appearance of mahogany. When the polish diminishes in brilliancy, it may be restored by the use of a little cold drawn linseed oil.

J. L.

QUERIES.

1. What is the reason of the appearance of falling stars?—L. M'L.

2. What is the best mode of securing lobby or room doors in cold weather, without the usual troublesome plan of nailing on pieces of cloth on the bottom of them?—P.

3. What is the best mode of preventing the smoke of a neighbour's vent from coming into one's own apartments?—Z.

4. Are old wives for any use on the tops of chimnies?—Z.

5. Should not the Superintendent of Public Works or Streets, take cognizance of the bad state of Ingram-Street, at the foot of John-Street, and order it to be mended?—M.

6. What is the best mode of preventing the water-pipes from freezing in this city? and, what is the best mode of loosening them when they are frozen?—N.

7. For promoting the health and comfort of our operatives, is not a set of baths, on a cheap and commodious plan, in a central situation of the city, a desideratum?—B. J.

SCIENTIFIC INTELLIGENCE.

Application of the Air Pump.—Mr. J. Oldham of the Bank of Ireland, has recently applied the air pump to many operations in the arts, and in which substances are to be impregnated with fluids, and with great success; thus, in the sizing of paper, for instance, the paper is piled up evenly in a vessel capable of being rendered air-tight, an exhaustion is made, the size introduced, and the air's pressure admitted; when the fluid passing into the pores of the paper rises it regularly, and without injury to the fabric. In the same way paper, silk, flax, cotton, and woollen staples, either raw, spun, or woven, may be dyed very regularly. In the processes of boiling, soaking, or pickling food, &c., this process may be used to remove the air and introduce the fluids, and its application is easy and evident in numerous similar cases. An apparatus of this kind is erected at the Bank of Ireland for wetting bank-note paper preparatory to its being printed on; an immense quantity of this paper is wetted without delay, and without any injury to the paper.

Adhesive Pelt.—Mr. William Wood of Bow, Middlesex, has discovered that a light felt of hide or hair, or mixture of hide, hair, and wool, when saturated with tar, is highly elastic and water-proof, and conceiving the useful application of the substance as a lining for the sheathing of ships, he manufactures it in an expeditious and economical manner, in sheets of suitable size for that purpose; such sheets being attached to the external sides and bottom of the ship, by simply nailing with copper nails, are covered with planking. The substance he terms adhesive felt; it possesses the property of elasticity in so considerable a degree, as to stretch uniformly without fracture or injury either to its texture, or its complete impermeability to water, whenever the ship's seams are opened by straining in hard weather, or in more dangerous cases of the starting of planks, or the breaking of timbers as in stranding. In all such cases this material forms an impenetrable and elastic case or garment for the whole ship's bottom, and in the case of the opening of seams by straining, it recovers its first dimensions with the return of the part so opened in the release of the strain; in such cases it generally falls into the openings in a certain degree so as to render them afterwards more secure against a recurrence. He also finds it to be a complete protection against every destruction of worm in all climates; this destructive animal is never known to penetrate the material in the slightest degree. The hair, or hair and wool, is prepared for felting by the operation of dressing or bowing, as in the practice of hat-making, and is felted in the usual manner. Sheets or portions, thus felted, are dipped into the melted tar and pitch, certain stated proportions to each other, and then undergo a slight compression to take away the extraneous or dripping quantity of the material; they are then exposed for a short time to air to dry and cool, and are considered fit for use.—*New Monthly Magazine.*

INGENIOUS GENERAL ENUMERATION OF THE SCIENCES.

From the Prospectus of the "European Review, or Mind and its Productions in Britain, France, Italy, Germany, &c."

Principles of all things—Elements which these *principles* originate—Beings which these *elements* form—Organs which these *beings* develop—Wants which these *organs* experience—Signs which these *wants* excite—Societies which these *signs* produce—Countries which these *societies* inhabit—Earth which these *countries* compose—*Planetary* System to which this *earth* belongs.

Here the accurate observer will perhaps allow the implicit dependence of each succeeding on each preceding head; and if we next show, that, under these heads, every individual science as naturally arranges itself, he will perhaps also grant, that we have traced the basis of a natural system.—We shall, accordingly, place these ten successive and dependent heads in the first column of the following table, and range after each, in the third column, the triple science which it involves.

General Heads.	*Particular subjects.*	*Names of the Sciences.*	*Including, among others, the following branches.*
Principles	Matter, Space, Motion *	METAPHYSICS	
	Extension, Divisibility, &c.	PHYSICS †	
	Number, Form, Magnitude *	MATHEMATICS	—Arithmetic, Geometry, Algebra, &c.
Elements	Atoms	ATOMOLOGY	—the doctrines of Heat, Light, Sound.
	Molecules	CHEMISTRY	—Electricity, Galvanism, Magnetism.
	Masses	MECHANICS	—Statics, Hydrostatics, Pneumatics.
Beings	Minerals	MINERALOGY	
	Vegetables	BOTANY	
	Animals	ZOOLOGY	
Organs	Forms	PHYSIOGNOMY	
	Structures	ANATOMY	
	Actions	PHYSIOLOGY	
Wants	Clothing	COSTUME	
	Food	GARDENING, &c.	
	Shelter	ARCHITECTURE	
Signs	Speech	LANGUAGE POETRY MUSIC	Grammar, Composition, Style.
	Gesture	GESTURE SCULPTURE PAINTING	
	Writing	LETTERS SYMBOLS HIEROGLYPHICS	
Societies	Families	MORALS	—Manners, and the Drama.
	Cities	CIVICS	—Statistics, ‡ Legislation, Administration.
	Nations	POLITICS	—the relations of Peace, Diplomacy, War.
Countries	Land	GEOGRAPHY	—Geology and Palæontography.
	Sea	HYDROGRAPHY	
	Air	AEROLOGY	—Meteorology.
Earth	Its Form, &c. Its Motion Its Effects	COSMOGRAPHY	
Planetary System	Their Forms, &c. Their Motions Their Influence.	ASTRONOMY	

* The subjects of these three lines differ considerably; but under Metaphysics, Physics as here employed, and Mathematics, they are all considered abstractly, and it is in that sense that we apply to them the general term—Principles.

† Extension, Divisibility, &c. are only the first subjects commonly placed under this head. We use the term in a limited sense. It is commonly used in a vague manner.

‡ Including the doctrines of property and money, as well as of population.

USFEUL RECEIPTS.—From the "ORACLE OF THE ARTS."

Wonderful but easy and effectual method of rendering all sorts of paper fire-proof.—This astonishing effect is produced by a most simple cause. It is only necessary, whether the paper be plain, written, or printed on; or even marbled, stained, or

painted for hangings, to immerse it in a strong solution of alum water, and then thoroughly dry it, when it will immediately become fire-proof. This is readily ascertained by holding a slip of the paper thus prepared over a lighted candle. Some paper however will require to imbibe more of the solution than it may receive by a single immersion; in which case the operation of dipping and drying must be repeated till such paper becomes fully saturated: when, it is asserted, neither the colour nor the quality of the paper will be in the smallest degree injured; but, on the contrary, both will be improved.

Art of making the best red sealing-wax.—To every ounce of shell-lac, take half an ounce each of resin and vermilion, all reduced to a fine powder. Melt them over a moderate fire; and, when thoroughly incorporated, and sufficiently cool, pour the composition into what are called sticks, of any length or thickness, and either flat or round as may be thought best. On account of the dearness of shell-lac, seed-lac is usually substituted, even in what is denominated the best Dutch sealing-wax. Boiled Venice turpentine may be used, with good effect, instead of resin. Thus may be made a fine red sealing-wax; which will not only do, what is often falsely impressed in the Dutch language, on very bad wax—"*Burn well, and hold fast,*"—but will also look well. A more ordinary sort, but sufficiently good for most occasions, may be made by mixing equal parts of resin and shell-lac with two parts of red-lead and one of vermilion, instead of all vermilion, according to the proportion above directed for the best wax, and to be made up in a similar way. In a still commoner sort, the vermilion is often entirely omitted; and even a very large proportion of whiting, strange as it may seem, is also actually introduced.

Permanent red ink for marking linen.—This useful preparation may be used either with types, a hair pencil, or even with a pen. Take half an ounce of vermilion, and a drachm of salt of steel; let them be finely levigated with linseed oil, to the thickness or limpidity required for the occasion. This has not only a very good appearance; but will, it is said, resist the action both of acids and alkalies. By substituting proper articles for vermilion, ink of other colours may be produced.

To make Sugar from old rags.—The conversion of starch, wood, and even rags, into sugar will, no doubt, surprise persons unacquainted with chemical research, but nothing can be more true. The chemical constituents of these different substances differ but little. The abstraction of a small portion of the carbon and hydrogen from starch converts it into sugar. By digesting potatoes with diluted oil of vitrol, for a day or two, at a temperature of 212° Fahrenheit, afterwards removing the acid by chalk, and concentrating the strained liquor by evaporation, crystals of sugar will be obtained. Saussure produced 110 parts of sugar from 100 parts of starch, from which he concluded that sugar was a peculiar compound of water and starch. Mr. Braconnot treated elm dust with oil of vitriol in the same manner as the starch, neutralizing the acid with chalk, and obtained a liquor which became gummy on evaporation. By triturating linen rags in a glass mortar with sulphuric acid, a similar gum is produced. If the gummy matter is boiled with diluted oil of vitrol, a crystalizable sugar is obtained.

NOTICES TO CORRESPONDENTS.

We have put W. B.'s initials to his communication, instead of 'Somebody,' which is absurd; he has assigned the true causes in answer to the queries, but his preliminary observations are erroneous.—L. M'L. and G. M. under consideration.—The articles promised in our last are unavoidably deferred till next week.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, and Original Patents, Inventions, &c. will be inserted on the shortest notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of Steuart & Panton, Cheapside, London; and Edward West & Co. Edinburgh.

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THE GLASGOW
MECHANICS' MAGAZINE.

"Art plies his oar, and Commerce pours her horn."—*Darwin.*

No. XLV. *Saturday,* 6*th November,* 1824. Price 3*d.*

REVOLVING PADDLES, COPYING MACHINE, AND AIR-BOAT.

Fig. 1

Fig. 2

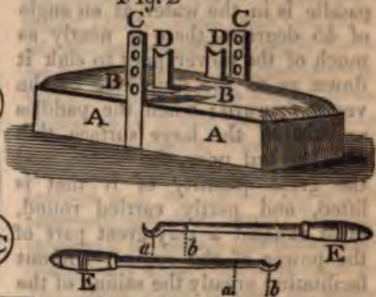

Fig. 3

Fig. 4

PLAN FOR REVOLVING PADDLES FOR STEAM BOATS.

Mr. Editor,—I hope I shall not be thought too bold, when I say, that the mode of fixing the paddles of the steam boats, which, so far as I know, is universally adopted in Scotland, is partly defective; for, when the descending paddle is in the water at an angle of 45 degrees, there is nearly as much of the power goes to sink it down as to the propelling of the vessel forward; when the paddles are rising, the large surface that acts upward upon the water, and the great quantity of it that is lifted, and partly carried round, must exhaust a very great part of the power of the engine, without facilitating greatly the sailing of the vessel; and when the paddles are sunk deep, by the vessel being heavy loaded, or the swell of the sea rising about her, the power of the engine is applied, under very great disadvantages, which would be avoided, in a great measure, by the adoption of revolving paddles. I recollect of seeing in a newspaper, some time ago, that they had been tried with great success on some of the English steam boats. But no account was given how they were wrought.

I therefore would propose a method that would accomplish the revolution, and, from the simplicity of it, would not be very liable to go wrong. Let as much room be left, between the inside of the frame, in which the paddles are fixed, and the outside of the vessel, as will be sufficient to contain a wheel of proper dimensions; through the centre of this wheel, the paddle shaft should go, and the wheel should be made fast to the side of the vessel. Now, supposing there were eight paddles in the circular frame, put four, or if ten paddles, put five intervening wheels, of proper diameters, placed upon studs, at equal distances around, on the side of the frame, and all pitched into the fixed wheel, but clear of each other; then put a wheel upon the end of the pivot of each paddle, of the same number of teeth as the centre one, and pitch two paddle wheels into each intervening one, observing to place the paddle perpendicular, when put in, in whatever part of the circle it may be. When all is properly fixed, the paddle frame may be turned either backward or forward, and all the paddles will still preserve their perpendicular attitude; whereby the paddle frames may be sunk, with advantage, much deeper than they presently can, and by their acting, in more solid and less broken water, by gently dipping with their edges, and rising in the same manner, the whole power of the engine would be applied to the pushing of the vessel forward.

In the event of the engine going wrong, when on a voyage, by fixing the centre wheel, in such a way, as it could be easily turned exactly one half round, all the paddles would be turned with their edges right fore-and-aft, which would allow the vessel to sail freely, the same as any other sailing vessel, during the time of repairs; which, when done, by turning back the centre wheel to its former situation, all the paddles would be brought to their proper positions for action.

Fig. 1. shows the position of the wheels, on the side of the frame, for eight paddles. A, the fixed centre wheel. B, B, B, B, the intervening wheels. C, C, C, C, C, C, C, C, the paddle wheels. The large circles and arms, are intended to represent one side of the frame. D, the paddle, with its wheel E.

If you think the above worthy of a place in your very useful Magazine, it will perhaps call the attention to the subject, of more able heads and hands than your's, respectfully,

J. S. L.

Glasgow, 1824.

NEW, SIMPLE, AND INGENIOUS COPYING MACHINE,

Invented by Mr. C. North of Wakefield.

Sir,—If you think the inclosed worthy of a place in your Magazine, please insert it. I was induced to send it, from seeing a machine of this nature described in Number XIV., invented by Taylor & Co., which, indeed, is the only attempt I ever recollect of seeing made to supersede the expensive, and, in some respects, inconvenient machines generally used. The inclosed slight drawing will, I presume, sufficiently explain my invention.

In fig. 2, A, A, represents a strong board, 1½ inch thick, with a 2 inch broad moulding round the edges, forming a shallow box, or bed, the size of a foolscap sheet of writing paper, viz., 8 inches by 13 inches. B, B, a 1½ inch board to fit within the moulding. C, C, upright pieces of iron turned over the bottom, and well fastened. These uprights, which in mine are 5½ inches long, ¾ inches broad, and ¼ inches thick, have holes in them, as represented in the figure. D,D, two pieces of iron, of similar strength, with concave tops to receive two round levers, and are screwed fast to the upper board. These act as fulcrums for the levers E, E, to work in; which levers may be of any convenient length, observing, that the power increases with their length; ⅝th iron rods will be a proper strength for common purposes. The power is acquired, by placing each lever with its crooked end in corresponding holes of the uprights C, C, (and according to the bulk of matter to press,) and resting in an horizontal direction over the fulcrums D, D. Then, with one hand on each lever pressing strongly down for half a minute, the impression is taken. The fulcrums should be so placed as to divide the pressure as equally as possible. The power will easily be seen by the dotted lines, marked *a*, *b*, on the levers, which represent the short arm. This instrument is simple, portable, and cheap, not more than from 10s. to 15s.; and from a trial of many months which I have made, I find that it answers the purpose perfectly.

There is one addition of which I am very desirous, but having hitherto failed in contriving such an improvement, I must beg the assistance of some able Correspondent of yours; and this consists in a plan by which the press may be locked, or fastened, when any thing is in it; this must be on a self-acting principle, as both hands are engaged, one acting against the other when pressing, and must lock itself at any required elevation, and also allow of being entirely disengaged when copying a letter, as it will in that operation be an incumbrance. Should any of your friends take this into consideration, and communicate the result, it will much oblige, Sir, your's,

C. North.

Wakefield, Sept. 30, 1824.

P. S.—The upper board has its edges rounded off a little for the sake of neatness.

PLAN FOR AN AIR OR LIFE BOAT,

Invented by Mr. Walter Ballantyne, Water of Leith.

Mr. Editor,—I believe it is customary to give an account of the origin of any new inventions sent you, at least you seem partial to that kind of information; the following narrative, on that account, will perhaps be acceptable.

I have long considered, that however serviceable the agency of air and water is to man, yet this may be still farther extended, particularly in the art of Navigation. It is the weight of water that buoys a ship, and it is probable that that which buoys her, will also be the means of making her move; this thought led me to investigate farther into the matter. I took a tube and immersed it in water, and I found that the resistance was in proportion to the size of the tube; and that on bringing it to an angular position, it continued its buoyancy in that direction. From this observation I considered the matter worthy of farther experiments. I provided the means necessary for that purpose, and was satisfied with the results: at last I constructed a boat of tin, in order to ascertain the probable success of my plan. The inclosed is a drawing of this boat, and I shall endeavour to give you an idea of the plan I propose.

With any tube, (it matters not whether it be square or round,) I suppose myself on board a ship, and place the tube at the angle of 40° or 45°. I then suppose the tube to contain a cubic foot of water, which weighs 62 lb. 8 oz. Now, if I lay hold of the rod, or shaft, made fast to the piston, fitted to the tube, and proceed to discharge the water out of it, what will be the effect? The water being an external body, will offer resistance like a wall or a rock; hence, in the act of discharging it, the ship will sustain the pressure of my foot, which must be in the direction of the tube. It is evident, therefore, that the vessel will be affected by such an impression; and if I continue to keep my station, the result is as evident, *viz.* that the effects will be continued; for the column of water will ever be the same, according to the vessel's bearings, whatever motion she may have over the surface of the water; and the effect will be like that of an infinity of columns all arranged so as to replace each other without diminution, except in a troubled sea; and even then she would be as often a gainer as a loser.

In the case of a life-boat, if the circumambient air is found sufficient to answer her buoyancy, there will be a gain; but if injection of air is found necessary, there will be a loss. In an air life-boat, it is evident that the buoyancy will be greater, when all her apparatus is attended to, and more secure and safe than a cork one. It will even be a matter of difficulty to upset her, especially when the air vessels are used together with the air tubes; the resistances may then be increased where it is wanted, and diminished in proportion on the opposite side. There is a question on which I acknowledge my ignorance, whether air be a perishable article in a state of violence, either by pressure or confinement? if it is not, it is possible that a vessel foundering at sea may never reach the bottom; for, as she descends, the column of water will encrease in proportion, and she may arrive at that point where she will be balanced by the said column, and so become stationary: or descend till the air explode her to fragments, or it may be condensed into what I know not; it may be

to fire or water; and it remains yet to be discovered what this change will produce. These inquiries may be considered as vain, since the vessel is irrecoverably lost, yet something useful may arise from them.

I made the boat of tin, in order to ascertain my plan; but, I am sorry to state, I had the misfortune to get my thigh-bone broken in such a way as baffled all the disciples of the great Munro to amend; and, what is more mortifying, it must for ever remain so; this has finally arrested all my industry.

I cannot determine its effects as to its propelling power, and farther experience will be necessary on the subject, but my experiments tell me it is considerable; this part of it I submit to your enterprising body * to carry into effect, as it is not in my power from the above cause.

The side view (fig. 4) of the boat shows the tubes; they are about an inch square; their lower end is open, and the boat is immersed in the water. The pipes are made leading to the air pump; (and it may be placed any where in the boat; where I have placed it, is not intended to be its final station; it is only placed there to show it more conspicuously.) There is a small pipe and cock leading into the tubes from the main pipe, along the gunwale; by working the pump, you will force the water out of the tubes, and fill all the other parts with such a quantity of air as is wanted. The angular tubes fore and aft are made to communicate with air vessels, in order to compress the air in them, which will increase its buoyancy, and relax or resist according to the agitation of the vessel. There are two air balls, one on the stem and another on the stern, to prevent her from upsetting; around her bows there is a space all filled with air; besides, her quarter contains large quantities of air.

I have given a bottom or keel view of the vessel, (fig. 3,) to show how the tubes and the air vessels are placed, which I think will easily be understood.

Round her gunwale, there is a rivetted rope, through which it passes; and at every bend a piece of cork to swim it and to keep it at a due distance from the side of the boat, so as it can be easily laid hold of; as many perish for want of such in time of danger, and I have been eye witness of it. In order to extend the means of preserving life, there ought to be at least one rope or line of this description, if not more, in every life-boat, as in a surf, or taking people from a wreck, they often lose their hold; this rope may be easily thrown off to the unfortunate, and he may chance to lay hold of it; the twinkling of an eye may save a valuable life by slender means; this is just a piece of cord line with three balls of cork to buoy up the line.

Suppose a boat of 30 feet long from stem to stern, where 18 tubes on every side will be easily placed, allowing 4 inches between each for a timber and fixtures; each tube 8 inches square, length 2 feet 3 inches, which is just a cubic foot in each; since 35 cubic feet of water weighs a ton, if this water were replaced with air, what would be its effects, operating instead of the former? I think, Mr. Editor, this is a question worthy of some trouble to determine. I am, SIR,

Your's, &c.

Walter Ballantyne.

Water of Leith, Oct. 22, 1824.

* He means the Mechanics' Institution.

RECENT PATENTS.

To Mathias Archibald Robinson, *of Red Lion-Street, in the Parish of St. George the Martyr, in the County of Middlesex, for his Invention of certain Improvements in the Modes of Preparing the Vegetable Matter commonly called Pearl Barley and Grits, or Groats, by which Material, when so prepared, a Superior Mucilaginous Beverage may be produced in a few minutes.*—Sealed 28th August, 1823.—Inrolled, February, 1824.

These improvements consist in a peculiar mode of drying and otherwise treating the grain, by which process its vegetating properties are destroyed, and a meal is produced, divested of rawness, and free from the impurities of husk or fibre. This meal, when so prepared, is entirely soluble in water, and will, with boiling water, produce a perfectly smooth, and almost transparent mucilage, in a few minutes.

The process of preparation is as follows: Any quantity of pearl barley, or groats, intended to be operated upon, is taken in the state it is usually sold at the shops, and the first process is to cleanse it from seeds, dust, and husks, or other impurities, by winnowing. After this the grain is carefully looked over, and any extraneous matters which have not been separated by the winnowing machine are to be picked out.

In this cleansed state the grain is to be spread over the bottoms of sieves, in level layers of about an inch and three quarters thick. These sieves are then deposited on ledges, in closets heated by steam boxes, or steam passages, the temperature of which should be gradually increased to 160 or 170 degrees of Fahrenheit's thermometer. Under this temperature, the grain is permitted to remain for about three hours, in order to dry gradually: the aqueous parts evaporated, being drawn off by suitable pipes leading from the hot closet. By these means the vegetating properties of the grain will be killed, and the raw taste removed without parching or roasting it.

When the grain has been thus sufficiently dried, it is spread out in large hoppers, or troughs, to cool, and this being effected, it is passed through the funnels of the hoppers down to steel mills below, where it is to be ground by hand, or other convenient power, sliders being placed in the funnels of the hoppers for the purpose of regulating the supply of grain descending into the steel mills.

The meal falling from the mills is received into boxes, and is to be thence removed for dressing into bolting machinery of the ordinary construction. The cylinders of these bolting machines should be made of fine wire gauze, of from twenty to thirty-six wires in the inch, and when the meal has passed through the finest of them, it may be considered to be completely fit for use.

The patentee states that a table-spoon-full of this prepared material, mixed up first in two spoons full of cold water, and made perfectly smooth, and then, with the addition of a sufficient quantity of water, boiled for a few minutes, will produce the mucilage called barley-water, of a very superior quality to that obtained by the ordinary process of boiling the barley for some hours, the mucilage being strained through muslin, and flavoured with lemon peel, or juice, and sweetened with honey or refined sugar.

An excellent and nutritive food for infants may be made by mixing the above preparation with milk and water, instead of water alone, It will also be found to be a very desirable material for thickening

broths; it may be mixed and introduced into the broth half an hour before it is taken off the fire.

The powder of the groats, prepared as above, is to be mixed in the same way, and gruel may be produced from it in ten minutes, and of a quality very much superior to that obtained from every other preparation of oats heretofore presented to the public; puddings also, of an excellent quality, may be made from this preparation.

The patentee states—" I am aware that several unimportant variations may be made in the process above described; but I wish it to be understood that I rest my claim of patent right in a method or methods of drying the grain under a regular temperature, without roasting or parching it, so as to destroy its vegetating properties, and at the same time retain its nutritive qualities unimpaired; by which preparation the meal is brought into a condition that will enable it to keep perfectly good in any climate."

To George Richards, *of Truro, in the County of Cornwall, for his invention of certain Improvements in Fire Grates, Stoves, Furnaces, and other Inventions for the consumption of Fuel; and in the Flues connected with them, whereby they are rendered more safe, and the Smoke prevented from returning into the Rooms in which they are placed; and also for an Improved Apparatus for cleansing the same.*—Sealed 26th December, 1822.—Inrolled June, 1823.

The patentee purposes to " make all kinds of grates and stoves to fix into metallic fire-places, or cases," these he intends to be lodged in suitable recesses or fire-places "leaving a vacancy behind the back part of about two inches," (deep, we suppose,) which vacancy he terms a rarefying box, this may be formed of thin iron or brick-work properly plastered, before the metal fire-place is set in. It is also intended to " make to these fire-places inner and outer hearths, instead of marble or any other material." The inner is to be " sunk below the outer, to allow of a dust or ashes vacuity, with a moveable grate or perforated metallic screen over it."

" Above the grates, at a proper height," it is proposed to " make a regulating valve, so constructed that when the cold atmospheric air presses down the chimney flue from eddy wind, or any other local cause which may prevent the ascension of the smoke, it may be conducted into the rarefying box, and its ill effects be there destroyed, instead of finding its way into the room." A door is to be made at the bottom of the metallic back to discharge the soot when the flue is swept. The flues of all chimneys are proposed to be made with metal plates, fastened together by tye-straps, and finished at top with neat architectural caps.

Kitchen ranges, and cooking apparatus, and all other kind of grates, are also to be made " upon an improved principle," *viz.* " the two horizontal bars at bottom and top, or occasionally the two at bottom only, to form the segment of a circle, or any other pretty curve upwards; so that, from either heat or cold, if contraction and expansion take place, the body of the grates may never sink down." The whole of the other bars of the grates are to be placed vertically, and " made hollow with receiving and discharging atmospheric vents." Cooking apparatus are also to be made with sliding ovens, boilers, and hot closets. to regulate the length of the fire; these may be heated by separate fires. The ranges are to have no fall-down bars, but when the fire is to be contracted the bottom is to be raised up; and if without ovens, boilers, or hot closets, an atmospheric vent-hole is to be made in the back.

"The vertical ranges may be made with sliding cheeks on a new principle; the top of boiler and oven to serve as a hot plate, and a plate also to hang or turn down over the fire-place, as a hot plate," with different culinary conveniences for boiling, stewing, and steaming in the back part. Concave metallic *roasting hasteners* are also to be made, upon an entire new principle, so that they may be connected with the grates, and be put in their position, and removed out of it, to allow the dripping of the meat with the greatest facility and adroitness."

Fenders are to be secured to the inner hearth by sliding studs. Fire-screens are to have "a groove, or rising, on the inner hearth, in an elliptical form, to embrace the lower parts of the screen, and by a worm, bent wheel, or other mechanism, the parts are to be brought forward and backward to meet the centre." The fire-irons are to be set with "a stepping in the hearth, and a rest connected with the fender, to preserve them in an independent vertical position." Pokers are proposed to be made with "a moving fulcrum, to suit the vertical grates, for stirring the fire."

"I also," says the patentee, "make furnaces with these fire-places, flues, and stops of cast-iron, whereby the fire is detained beneath the bottoms, and all round close to the sides of the boilers, until the whole strength of the combustion of the fuel is quite exhausted. This improved application of a metallic furnace for brewing, sugar-refining, for distilling, and every other purpose where fire is applied under any metallic vessel for boiling a fluid, is of the first importance; the fire-door, too, must have a lining on the inside, to prevent the chilling action of the atmospheric air."

An improved apparatus is mentioned for sweeping chimneys of all descriptions, and explained as follows: "I make a metallic case to suit or fit chimney-pots, of brick or other substance; this case contains an open metallic cylinder, with a projecting flanch on its outer top edge. The use of this is to prevent the operation of eddy winds from an easy entry, (after rebounding against the pot,) into the flue; the cylinder is made to turn easy on its pivots, and the case I fix in a secure manner to the top of the chimney," (or extremity of an horizontal flue.) "This being done, a whalebone needle, made with brass ferrules, and jointed in short lengths, with a swivel friction roller at the fore or lower end, is put down the flue; and, however crooked and intricate, this needle will reach the bottom, or extreme distance, to which a small line is fixed; the line from the bottom end is then taken off, whilst the line at the top is held by the person who sent down the needle. The needle is then drawn up the chimney, and folded together in its joints, and the person above puts a strong well made metallic chain properly over the cylinder, and securely fastens both ends to the line or cord, the person below then pulls it down."

If the soot adheres very firmly to the chimney, it is proposed to attach a scraper to the above, this is to be made to scrape on one side only, and to be pressed thereto by a spring, and to operate in its descent only; a whalebone brush is also to be used, made square or cylindrical, and attached to the chain; but differently formed scrapers and brushes are to be made, suited to the chimney in which they are to be employed. In case of the chimney taking fire, it is intended "to make a swab of the thrums, or any other like material, and secure them to a cylindrical block, which swab is to be made completely wet." In

this state it is to be drawn up and down the chimney, by means of the chain above-mentioned, until the fire is extinguished. Every house is to be provided with an apparatus of this kind. Chinese chimney caps are also to be made either of metal or earthenware, in order to screen the metallic chain and cylinder, within the chimney, from the effects of rain and snow. Wooden frames are proposed to fit the mantle-piece, and cloths to be attached to these frames, with sleeves in the cloths for the chimney-sweeper to put his hands through; the object of which is to exclude any of the soot from the room.

SKETCH OF THE HISTORY OF PHILOSOPHY,

Particularly with reference to Mathematical and Mechanical Science.

(Continued from Page 233, Vol. II.)

LEONARDO, a wealthy merchant of Pisa, is said to have been the first who introduced Algebra into Europe. Lucas de Burgo, however, was the first author who published a work on the subject. He employed the letters *p* and *m*, to denote *plus* and *minus*, and laid down some of the simplest rules of the Science. It appears evidently from this, to have been at first only an abbreviation of common language, like a system of short hand, applied to the solution of problems. To such a simple contrivance was Science indebted for the most wonderful instrument that was ever employed in the developement of human ideas. The algebraist seems to operate with his characters in the most mechanical manner; yet every line is full of thought, and is capable of being expanded into whole pages of ordinary language.

A discovery of the work of a Greek, Diophantus, who treated of such problems as were suited to the nature of this new notation, contributed not a little to the advancement of the Science of Algebra. This author, though unacquainted with the Algebra of the Hindoos, had, by means of common language, and the assistance of a few symbols of his own invention, arrived at the solution of quadratic equations; farther than this, even the Science as it was known in Europe, had not advanced.

The solution of Cubic Equations was accomplished by three individuals in a very curious manner. Scipio Ferreo, a Professor of Mathematics at Bologna, was the first who discovered a rule for solving one of the cases of these equations; this rule he communicated as an important secret to one of his scholars, who, desirous of showing off his wonderful skill, challenged one Tartalea to contend with him in the solution of problems. Tartalea, however, soon discovered the rule for the particular case in question, and extended it to all other possible cases. Cardan, a physician of Milan, being about to publish a work on Algebra, at the period of this discovery, and having heard of it, was very desirous to obtain a knowledge of it, as an excellent addition to his work. At first he could not prevail upon Tartalea to reveal the secret, but afterwards the latter was overcome by his solemn protestations not to divulge it to the world. The words which he made use of, were these, "I swear to you on the holy evangelists, and by the honour of a gentleman, not only never to publish your inventions, if you reveal them to me; but I also promise to you, and pledge my faith as a true Christian, to note them down

in cyphers, so that after my death no person shall be able to understand them." To this, Tartalea replied, "If I refuse to give credit to these assurances, I should deservedly be accounted utterly devoid of belief." Notwithstanding these solemn assurances to the contrary, Cardan did publish Tartalea's method, and though we may justly reprobate the former for his total disregard of his oath, we cannot regret that the latter should have been disappointed in his intentions of making a mystery of knowledge, and of keeping his discoveries secret, for no other purpose than what must be considered as purely selfish. In the succeeding century, men were actuated by more enlightened views, and the establishment of Scientific Societies and Academies, for the communication of knowledge, showed not only a spirit more worthy of philosophy, but was attended with the most beneficial effects in the amelioration of the race.

The solution of the well known irreducible case of cubic equations, by a direct formula, was a problem in which not only Cardan, but all the mathematicians of Europe, since his time, have failed. Like the quadrature of the circle, or the trisection of an angle, it seems destined to employ the ingenuity of mathematicians in vain. A general method of resolving cubic, as well as all other equations, has lately been discovered by a person in London; not, however, by direct formulæ, but by a tentative process which at last brings out the exact root, in a manner similar to the common mode of extracting the square and cube root of numbers. This discovery, though original perhaps on the part of the author, (Mr. Holdred,) was first made by a countryman of our own, a Mr. Halbert of Auchinleck, who published it at the end of his very curious work on Arithmetic, and it was there applied by him to the solution of the irreducible case of cubic equations.* From this, it was easy to extend the plan to the solution of equations of all degrees; but whether Mr. Holdred had seen the work of Halbert, is a question which may not be easily answered; at all events, there can be no doubt that the latter was the original discoverer of the method, though it was much farther extended by the former.

Various eminent men made successive discoveries in the Analytic Art, among whom Vieta and Harriot were not the least remarkable. The former was the first who employed the letters of the alphabet to denote the known as well as the unknown quantities in Algebra, by which important step the symbolic language of this science first became capable of expressing a general truth by means of a single formula; a circumstance which has since that period rendered it, in the hands of the geometrician, a powerful instrument of investigation and discovery, and like the fabled wand of the magician has enabled him to penetrate into the mysteries of nature. In his treatise on angular sections, he appears to have been also the first who applied Algebra to Geometry, an honour which has been generally ascribed to Descartes. Harriot, the next in order, was the inventor of the general method of finding the origin of all equations, by the continued multiplication of simple equations. This step completed the theory of equations, showed many beautiful properties belonging to them, which mightily aided the algebraist in his endeavours to obtain their resolution; and, in a word, brought it very nearly to that state

* We have often employed this method before Mr. Holdred's plan was ever heard of.—*Ed.*

rfection in which it now exs an abstract science.

era now occurred, however, application, perhaps the most tant in modern science, when nsider that it paved the way e of the grandest discoveries wton. Descartes was the first pplied algebraical analysis to vestigation of the nature and rties of curve lines, and intro- into Geometry the notion of able quantity; he solved one most general problems which itherto attracted the notice of maticians; this problem was etermination of the locus, or of a point, having a certain on to four straight lines, and perpendiculars; and he showed he said locus, or place of the was always according to that relation, one of the Conic Secviz., either a circle, an ellipsis, bola, or a hyperbola. He ind a method of drawing tanto curves, a branch of analysis was afterwards improved by t, Roberval, Barrow, and on, the latter of whom, by his igations on this subject, was the invention of Fluxions.

ring the period of continental ery, Scotland was not without ustrious contributions to the al advancement of Science. abour of calculation and the employed in it, had become, nsequence of the discoveries were from time to time eng the dominions of philosophy, ly very great, but extremely e to mathematicians, and all, to astronomers. Baron r of Merchiston, a learned and particularly attached to udy of astronomy, desirous of himself the trouble of the te- arithmetical operations, in he always found himself in- in his investigations, set his ity to work to discover a method of accomplishing his desire. He observed the coincidence which occurred in the addition or subtraction of the terms of an arithmetical series, considered as the indices of a geometrical series. He saw that when one term of the latter series was to be multiplied by another, he had only to add the indices, which stood above them in the arithmetical series, and searching for the sum in the same series, he found immediately below it, in the geometrical series, the product required. He observed, that division could be performed in the same way; and he consequently inferred, that all operations in multiplication and division, could now, by means of a table properly constructed, be performed by addition and subtraction alone. Such an idea had formerly occurred to Archimedes, but for want of a proper system of notation, the idea had never been farther pursued; the tide of his ideas had, in fact, soon after flowed beyond it, and in the long series of dark ages that succeeded, no genius less lofty was found to supply the deficiency, till the torch of science again illumed the world.

The distance of nearly 2000 years was requisite for the completion of this simple discovery, and the honour of the invention of logarithms, the most useful instrument ever put into the hands of the arithmetician, was reserved for our illustrious countryman. The character of Napier and his discoveries, have been thus drawn by a late elegant writer:—

"As there never was any invention for which the state of knowledge had less prepared the way, so there never was any where more merit fell to the share of the inventor. His good fortune also, not less than his great sagacity may be remarked; had the invention of logarithms been delayed to the end of the 17th century, it would have come

about without effort, and would not have conferred on the author the high celebrity which he so justly derives from it. Many inventions have been eclipsed or obscured by new discoveries, or they have been so altered by subsequent improvements, that their original form can hardly be recognized, and, in some instances, has been entirely forgotten. It has been quite otherwise with the invention of logarithms, which came out of the hands of the inventor so perfect, that it has never received but one material improvement, that which it derived, as has just been said, from the ingenuity of his friend in conjunction with his own. Subsequent improvements in Science, instead of offering any thing that could supplant this invention, have only enlarged the circle to which its utility extended. The sagacity of their author did not see the immense fertility of the principle he had discovered; he calculated his tables merely to facilitate arithmetical, and chiefly trigonometrical computation, and little imagined that he was at the same time constructing a scale, whereon to measure the density of the strata of the atmosphere, and the heights of mountains; that he was actually computing the areas and the lengths of innumerable curves, and was preparing for a calculus, which was yet to be discovered, many of the finest and most valuable of its resources. Of Napier, therefore, if, of any man, it may safely be pronounced, that his name will never be eclipsed by any one more conspicuous, or his invention superseded by any thing more valuable."

Such was the splendid advances which had been made in the pure Mathematics; the discovery of every new truth in them, led to others in the Physical Sciences; they necessarily went hand in hand in the progress of discovery, and whenever they were separated, the latter fell into decline; without the former, our knowledge of nature must have continued to the present hour, vague and uncertain; and one system of philosophy must have continued to give way to another, till there was perhaps nothing left of truth in any system on the face of the earth. But as the original inventors continued in the course of their labours to establish every fact on well founded experiment, and to deduce their inferences by mathematical demonstration, the result could be no other, than a body of scientific knowledge, which it was impossible to overthrow. The bolder spirits had already burst the trammels of ancient authority in every thing that was not founded on experiment and demonstration; they had ventured to question opinions sanctioned only by antiquity, and now proceeded to explore with a fearless eye the wide fields of human knowledge.

(To be continued.)

VARIOUS COMMUNICATIONS.

ELECTRICAL ATTRACTION.

SIR,—J. V., in your Number for 24th April, wishes to know why a piece of paper, after being rubbed with India rubber, adheres to the table, and attracts light substances. In my opinion, the phenomena proceed from two causes: it adheres to the table, because the action of rubbing expels the air from between the paper and the smooth surface of the table, and acts in the same manner as the sucker used by the boys in dragging stones about the streets, to the no small annoyance of the lieges, particularly of the fair sex, whose snow-white robes suffer sometimes in the experiment. The attraction is caused by electrical phenomena. It is well known, that all

sorts of gums and resins are more or less electrical; in the present case, the paper is excited by the India rubber, and being, when dry, a non-conductor, it will attract small light substances, in the same manner as excited sealing-wax, amber, gum, lac, &c.

Two simple experiments will suffice to show the truth of what I have advanced. Let your Correspondent cut with a pen-knife, straight lines in the paper, about half an inch long, and pretty near each other; then rub the paper in the direction of the lines, so as not to tear it, he will find that it will no longer adhere to the table, because the air will be admitted by the holes he has cut; let him then pass a piece of smooth metal (say a common smoothing iron) over the paper, and it will lose its power of attraction—the iron having deprived it of the redundancy of electricity, communicated to the paper by the India rubber.

Heating the paper increases the electrical power. Two small spirit lamps, one placed under the cylinder, and the other under the prime conductor of an electrical machine, increases its power very much, especially in damp or moist weather.

If J. V. will pull two silk stockings quickly asunder (the one having been previously put inside the other) in a dark chamber, provided both stockings have been well dried, he will see some striking electrical phenomena.

Or take a cat into a damp room, and rub the hair on its back pretty smartly against the grain, (up towards its neck,) it will also exhibit the electrical phenomena pretty strongly; but let him beware in this experiment, as it is rather a dangerous one; the motto of the Gordons will probably occur to him—

"Touch not the cat but a glove."

I am, Sir, your's, &c.

Y.

Glasgow, 1824.

MODE OF MAKING HIGHLAND WHISKY.

Sir,—The objects which in his travels through this wondrous world claim the eye and admiration of man, are many indeed and multiform! *Art* itself, (not to speak of *Nature*,) affords a world of wonders! And here, Mr. Editor, we might just refer the world to the Mechanics' Magazine, and have done; but our present object is to present a fresh and refreshing object to view. That the liquor called *Whisky*, owes its derivation (if not spurious) to that dull insipid seed called *bear*, or *barley*, every body knows. Of whisky, the products and properties are truly strange! It brings things out of their very contraries! The miser it makes generous, the quiescent quarrelsome, and the reserved loquacious! It turns fear to courage, hatred to friendship, and *vice versa!* Whisky is also medicinal! This fact, medical men well know, and unmedical men know it too. We, ourself, (to adduce one instance of a thousand which might be adduced,) have known an aged man who, being afflicted with *rheumatism*, had been for years closely confined, but who, being at his daughter's wedding, induced somehow to make free with this cordial, *danced* himself in one night *whole* every whit! The fruits and effects of whisky are different upon different minds.* It sets one man asleep, another man a-singing! It makes one man furious, another calm and courteous! In this, however, its effects agree on all—that it teaches all a certain reel!

But, Mr. Editor, of the mode of making this curious beverage, are the curious public hitherto really ignorant? They won't, under leave of you, Sir, be longer so; although we would fain wish the task had been imposed upon some abler pen. Know, then, that the barley being, in the first place, immersed in sacks, is for three days soaked in standing water; after which, it is taken out and made a mountain-like heap upon the bare floor. In this "heating heap" it remains until it begins to sprout beard, (possibly four days,) then it is spread to the depth of six inches or so over all the floor; we now call it *braich* (malt). Here it must be turned and shuffled three times a day, till the seed imbibes its moisture and regains its former temperature. This done, it is transferred to the kiln, to dry it, of course; and then, to the *mill*, to be not altogether mealed, but merely broken and bruised. This crude consistence is now condemned to a vast vessel called a *vat*, and there drowned with warm water—this is called mashing; and now that the subtle *steam* be denied all egress, special care must be taken. Being sufficiently mashed, the fluid is run off through a narrow vent into another cistern—this fluid we de-

* Should it not be "bodies?"—P. D.

nominate *braichleis*, (cosmetic lotion, or wash). In this *braichleis*, while yet milk-warm, a certain quantum of barm is put, which little supplement gives it the name of *cuttrachan* (maddener); perhaps because the thing is now really mad: for the barm so ferments it, that it requires a person for days, without intermission, to govern it; or because, in this state, to transport one beyond all the bounds of soberness, a small quantity serves. The *cuttrachan*, having at length assuaged its rage, is made over to the *still* and boiled; when, every crevice being stopped, the boiling matter seeks its fairy way in steam or vapour through the worm; but the worm being immersed in cold water, this vapour, in course of its mazy progress, is converted into solid whisky, which is very properly called *ciad-tharrin*, (first issue, or shot,) which first issue is just condemned to the still a second time, in order to refine it, and render it pure and potable usquebeatheo, (living water, or whisky!) In this recipe, Mr. Editor, we have perhaps overlooked some little punctillios connected with the process,* but our purpose was, neither to make brewers, nor mend them, but merely to gratify the public with an *outline* of the *mode of making whisky*.

I am, SIR, your's, &c.

L. M'L.

Coll, October, 1824.

FLUID AND SYPHON QUERIES SOLVED.

FLUIDS, of whatever description, are subject to the laws of gravitation as well as solids; and hence may be explained the phenomenon mentioned in the first query of your last Number. The stream of liquid is at first of the same size as the aperture from which it flows; but, as it recedes from the aperture, the speed increases, and thus it is drawn out finer and finer, till at last getting too small for the adhesive nature of its particles, it breaks into drops and so falls to the ground.

Your second query must be explained too by the laws of gravitation. The syphon is exactly the same as two weights of unequal sizes, fastened one to each end of a rope, and hung over a pulley. The heavy weight answers to the water in the long arm of the syphon, and the light weight to the water in the short one. The heavy weight and the fluid in the long arm, preponderate both from the same cause. But the short arm of the syphon being still immersed, gets a constant supply by the pressure of the atmosphere, which acts here the same as on a common pump, whereas the light weight on the rope, if left to itself, flies up and over the pulley. But to make the thing plainer to the capacity of your doubting Correspondent, suppose you get a glass syphon, with one arm three or four times the length of the other, and put a small string through it, with a button attached to each end, the exact size of the aperture: then, keep one of the buttons out at the end, while you fill the tube with small shot; that done, put in the button and turn down the arms of the syphon, when you will find that the shot will rest upon both buttons, but that which is in the long arm will preponderate, and the whole will fall through it to the ground; the same result will take place if you fill it with water instead of shot.

W. B.

Glasgow, 21st October, 1824.

SOLUTION OF THE POLE QUERY.

(No. XLI. page 190, Vol. II.)

THIS Question may be put as follows: Given the base (21), and the sum of the hypothenuse, and the other side (63), to find the length of that side.

Let x = length of the side; then x, $63 - x$, and 21, are the three sides of the triangle. But, by Euclid, 1st and 47th, $x^2 + 21^2 = (63 - x)^2$; or, squaring both sides, $x^2 + 441 = x^2 - 126x + 3969$; or, $126x = 3528$; whence, $x = 28$ feet = height of the fracture.—J. M'L.

* You should not have done so.—ED.

SCIENTIFIC INTELLIGENCE.

REMARKABLE ELECTRICAL PHENOMENA.

THE following relation is made by M. *Allemand of Fleuvier* Neuchatel, to M. Pictet, and is published in the Bib. Univer., June 1821.—M. Allemand, on the 3d of May, about ten o'clock in the evening, was caught in a violent storm

of wind and rain. The thunder becoming frequent and strong, he thought it proper to close an umbrella he had with him, and hold the upper metallic point in his hand, lest it should attract the lightning. The night, dark of itself, was made more so by the great rain. Suddenly he perceived a light from above, and looking upwards found the edge of his hat luminous. Supposing, at the moment, the hat was on fire, he, without reflection, passed his hand over the light to extinguish it. It, however, only shone more strongly; a circumstance which caused some confused ideas on the nature of the light. The hand being filled with water from the hat, on shaking it, M. Allemand saw that the interior of it shone as if it were a polished metal reflecting a strong light.

Being at this time near the farm of Chaux, about ten or twelve minutes' walk from Fleurin, and fifteen or twenty from Motiers, M. Allemand considered for a moment what he had best do, and concluded on continuing his progress. Having once filled his hand with the electrified water with impunity, he ventured to repeat the experiment, and did it fifteen or twenty times, endeavouring to ascertain whether it had odour, or produced any decrepitation or sound; but nothing of this kind could be perceived, nothing but the bright light which seemed like a brilliant varnish on the hand. The light remained for an instant only. At a few hundred paces farther on, the light on the hat still continuing, M. Allemand was surprised by the appearance of another light less bright than the former, on the smooth surface of the umbrella-handle, at the place where generally a plate of metal is placed for the name, but which plate had been removed from this umbrella. At first the finger was passed over it to extinguish it, but the phenomena were just as before, and both the rubbing and rubbed surface shone brightly. Afraid of the metal about the umbrella, it was thrown down, and M. Allemand went on his way, rubbing his hat on the sleeve of his coat; but in this way only rendering the light brighter. The thunder was more frequent than before, but still at some little distance. The crown of light continued until M. Allemand arrived near Motiers, and he attributed its cessation to the higher poplar trees in the neighbourhood of that place.

Stopping at Motiers only a short time, he took a guide with a lantern to find the umbrella. Having done so he sent back the man, and went on himself towards Fleurin.

As the tempest had diminished, he used the umbrella; and as soon as the light of the lantern was sufficiently removed, he again remarked luminous appearances. These occurred at each end of the whalebone ribs, on the metal point which terminates them; the light was not so bright as the electric star, but were brilliant points like a yellow red metal, highly polished, and would, M. A. remarks, have appeared very beautiful if he had been collected enough to admire them.

M. Allemand explains these effects by supposing the atmosphere sursaturated with electricity, and that a portion of it was continually passing to the ground, through his hat, umbrella, and himself. —*Journal of Science.*

WOULF'S APPARATUS IMPROVED.

The following form of Woulf's apparatus is due to the Marquess Ridolfi. The bottles have three apertures as usual, and the middle one intended for the purpose of cleaning the bottle, or the introduction of materials, is closed either by a cork or a stopper; tubes descend by the other two into the bottles, as is usual, one a little way, in the other nearly to the bottom; these tubes are small, they are fastened into the neck of the bottle, and do not rise far above, perhaps three inches, before they terminate; each of these tubes is surrounded on the exterior of the bottle by a considerably larger tube as high as themselves, and fastened by cement on to the top of the necks or tubulars, so as to form a little vessel to receive mercury round the outside of the smaller tube. The connexion is then easily made between one or more of these bottles by glass tubes bent twice at right angles, and of such size as easily to slip in between the two tubes before described; when the lower ends are immersed in the mercury, all is tight, and the apparatus may be set to work. This contrivance allows a little motion to the bottles without endangering them; they are instantly connected or unconnected at pleasure, and they act to a certain extent as tubes of safety.—*Ib.*

TO BRONZE PLASTER FIGURES.

LAY the figure over with isinglass size until it *holds out*, or without any part of its surface becoming dry; then with a brush, such as is termed by painters a sash-tool, go over the whole, taking care to remove, while it is yet soft, any of the size that may lodge upon the delicate parts of the figure. When it is dry, take a little very thin oil gold size, and with as much as just damps the brush, go over the figure, allowing no more to remain than causes it to shine; set it aside in a dry place, free from smoke, and in eight-and-forty hours the figure is prepared to receive the bronze.

The *bronze*, which is a powder almost impalpable, may be found at the colour shops, resembling all the metals, and should be dabbed on with a little cotton wool. After having touched over the whole figure, let it stand another day, rub off all the loose powder, particularly from the *points*, or more prominent parts of the figure; it will then resemble the metal intended, and possess the quality of resisting the weather.

Brass being the metal commonly imitated, the experimentalist may chose to make it himself. In that case, let him dissolve copper filings in *aquafortis*.—When the acid is well impregnated with the copper, the solution must be poured off upon some scraps of iron, whereby the powder will be precipitated to the bottom of the liquid; this being poured off, the powder is to be repeatedly washed in clean water. When dry, it is fit for use. —*Oracle of the Arts.*

REFLECTING LIGHT-HOUSES.

THE use of mirrors for reflecting light-houses in England is of very recent date; and, although the idea was not suggested by the falling of an apple, nor the dissection of a frog, it owes its origin to a circumstance almost as trivial, which was as follows: At a meeting of a Society of Mathematicians at Liverpool, one of the members proposed to lay a wager that he would read a paragraph of a newspaper, at ten yards distance, with the light of a farthing candle. The wager was laid; and the proposer covered the inside of a wooden dish with pieces of looking-glass, fastened in with glazier's putty, placed this reflector behind his candle, and won the wager. One of the company viewed this experiment with a philosophic eye. This was Captain Hutchison, the dock-master. With him originated those reflecting light-houses at Liverpool, which were erected in the year 1763.

In his Treatise on Practical Seamanship, he says, "We have made and had in use here, at Liverpool, reflectors of one, two, and three feet focus, and 3, 5½, 7½, and 12 feet diameter, the three small ones made of tin soldered together, and the largest of wood covered with looking-glass. The two large ones, called the sea-lights, leading through the channel from the sea, till the two Hoy-lake-lights are brought in a line that leads into a very good road-stead to lie, till it is a proper time to proceed to Liverpool."

EASY MODE OF TAKING PERMANENT IMPRESSIONS FROM SEALS.

PLACE a piece of common lead on the top of a wax impression of any seal, strike it a smart blow with a hammer, and you will obtain an accurate and permanent impression of the seal on the lead. The same method may be applied to coins, medals, &c. by first taking an impression of them in wax, and then an impression of these in lead.

NOTICES TO CORRESPONDENTS.

Mr. R. R.'s (Aberdeen,) ALARUM APPARATUS will be inserted.—J. R. copies from other Journals without acknowledgement, and sometimes not very correctly; this being the case with his last, we trust he will amend both of these faults in his next communications.—Mr W. S.'s (Edinburgh,) solution of the pole query is superseded by that of J. M'L. which he must confess is much shorter and clearer.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, and Original Patents, Inventions, &c. will be inserted on the shortest notice.

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CURLL, PRINTER.

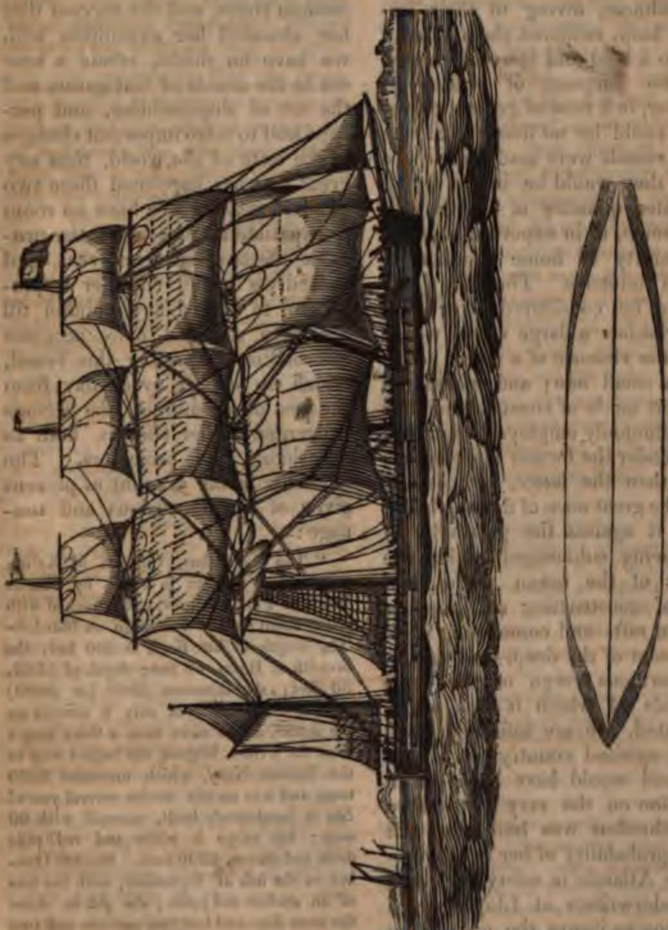
THE GLASGOW

MECHANICS' MAGAZINE.

"Soon shall thy arm, unconquer'd Steam! afar
Drag the slow barge, or drive the rapid car;
Or on wide-waving wings expanded bear
The flying chariot through the fields of air.
Fair crews triumphant, leaning from above,
Shall wave their fluttering kerchiefs as they move;
Or warrior bands alarm the gaping crowd,
And armies shrink beneath the shadowy cloud."—*Darwin.*

No. XLVI. *Saturday, 13th November*, 1824. Price 3*d.*

THE LEVIATHAN OF THE DEEP, THE FOUR-MASTED SHIP COLUMBUS.



THE FOUR-MASTED AMERICAN SHIP COLUMBUS, THE LARGEST THAT EVER WAS BUILT,

Arrived in the Downs on November 1st, 1824, after a passage of 54 days, from Quebec.

The complete defeat, and almost total destruction of that formidable armament, the Spanish Armada, partly by the skill and bravery of the English, and partly by the violence of a severe storm which overtook it when passing the Orkneys, was a proof that large vessels were by no means calculated for the purpose of invasion, and that their own unwieldiness, owing to their immense bulk, rendered them an easy prey to a bold and intrepid enemy. For the purposes of commerce, however, in a time of general peace, there could be no doubt that the larger vessels were made, the more useful they would be in conveying a greater quantity of foreign produce home, or in exporting a greater quantity of home produce to foreign countries. The only question to be considered after this, was whether a large vessel would resist the violence of a storm better than a small one; and whether a different mode of construction than that commonly employed might not only render the former more secure even than the latter, or perhaps from the great mass of floating body, insure it against the possibility of ever being submerged under the waters of the ocean. The bold idea of constructing an immense wooden raft, and committing it to the bosom of the deep, loaded with an enormous cargo of the same materials of which it was made, originated, we are informed, with a very spirited countryman of our own, and would have been put in execution on the very spot where the Columbus was built, had not the improbability of her ever crossing the Atlantic in safety, deterred the underwriters at Lloyds' from venturing to insure the proprietors *against loss. This led to a departure from the original* idea, and resulted in the building of the Columbus, in its present form, which is exhibited in the engraving. Notwithstanding her amazing size and peculiarly simple construction, this vessel, according to all accounts that have as as yet transpired, is said to sail remarkably well. We believe she has never been equalled in magnitude, either in ancient or modern times, and the success that has attended her expedition will, we have no doubt, create a new era in the annals of Navigation and the art of ship-building, and perhaps lead to more important changes in the state of the world, than any event that has happened these two hundred years. We have no room to expatiate at present on the probable effects of such an event, and indeed we would consider it premature to hazard any opinion till we have received more accurate information respecting this vessel, which *we* expect every day from the best of all sources, the persons concerned in her success, both as proprietors and projectors. The following is the account at present given of her dimensions and tonnage:—

"The Columbus, Captain M'Kellar, was built at Quebec in 1824, by Charles Wood of Port-Glasgow, and launched with about 4000 tons of her cargo on board.—The length of her Keel, is 300 feet; the breadth of Beam, 50 feet; depth of Hold, 30 feet; she measures 3800 (or 3690) register tons; she was only 9 months on the stocks, and is more than a third longer than the Prince Regent, the largest ship in the British Navy, which measures 2620 tons, and was on the stocks several years! She is handsomely built, manned with 90 men; her cargo is white and red pine deals and staves, 6300 tons. She left Quebec on the 5th of September, with the loss of an anchor and cable; she got on shore the next day, and lost two anchors and two cables; finally left Point des Busianites on the 12th of September, and anchored in the Downs on the 1st November at 3, P.M.

REVIEW OF A TREATISE ON THE ART OF WEAVING,

Illustrated by Engravings, with Calculations and Tables, for the Use of Manufacturers. By John Murphy.—Glasgow, 1824.—Pp. 496.

Weaving has been considered by many as quite undeserving the name of an art, its processes have to them appeared as simple, and easy to be understood, and they have thought it strange that any instruction should be requisite regarding its principles; but no sooner have they found occasion for their boasted knowledge than they have discovered their ignorance. Weaving *is* an art, and one, too, so intricate and ingenious, that we question much if many of the operatives even in this city, famed as it is for its manufactures, are possessed of more than a nominal acquaintance with the principles of their profession. We are aware, however, that they urge, as an excuse for this deficiency, the close application they are obliged to give to their employment, in order to support themselves and families; yet we do think, that if they devoted but a small portion of their time to the study of the principles of fancy-weaving, their situations might in many respects be made more comfortable. We say this the more confidently, because we are aware that the fancy-weaver makes, upon the whole, better wages than the plain weaver; he has studied the principles of his art, and of course reaps all the benefits which can be derived from such knowledge.

We have made these remarks, for the purpose of calling the attention of our readers to a work which we conceive to be of great importance to many of them. We formerly took notice of a Treatise on the Art of Weaving, by our ingenious townsman, Mr. John Murphy, which was then in the press, and we are now happy to announce, that, after great labour and expense, the *work is at length* completed, and does honour to our city. The author has taken a very extensive view of his subject, and has entered into all the mazes of this complicated art. The manner in which he has developed its elementary principles seems to invite the man of science to a study hitherto little attended to, except by the operatives themselves; he has most ably supplied a desideratum in manufactures, and it has appeared at a most favourable period. The reduction of the duties on silk has now placed our manufacturers on a more equal footing with their foreign rivals, and they may now enter into a more hopeful competition; to such, this book will be of important advantage; numerous branches of the art to which silk may, we think, be applied with success, are laid down with a clearness and distinctness which we have never seen equalled by any writers on the subject. In the choice and arrangement of colours, he will find this Treatise of great importance, as will be seen from the following extract:

"In the coloured branches of weaving, the distribution or arrangement of colours in a pattern is of no less importance than the choice of objects. Any person who has the least experience in disposing of colours, either in pictures or patterns, will perceive that some colours will have more brilliancy and effect when placed together, than when they are placed separate, or beside some others. This arises neither from taste nor caprice, but is founded in nature, and may be explained on the principles of optics; for it is well known that the seven prismatic colours have exactly the same relation to each other as the notes in an octave in music: and, therefore, the effect produced by artfully disposing of the kindred colours is no less pleasing to the eye, than the concords of musical sounds are grateful to the ear.

"Colours, therefore, with respect to the

effect which they thus produce, may be arranged under two heads, namely, those which are contrasting, and those which are harmonizing. The contrasting colours are such as are most opposed to each other; the harmonizing colours are those intermediate tints which lie between the contrasting ones, and as it were blend them together.

"The contrasting colours may be discovered by a very simple optical experiment. Place, for example, a red wafer on a sheet of white paper, and look on it steadily for some time till the eye becomes tired, and a ring of green will begin to appear round its edge; and even after the eye has been removed to another part of the paper, the green ring will be still visible. Hence, green is said to be the contrasting, or as is sometimes termed, the accidental colour of red; as red, on the contrary, is the contrasting colour of green. In like manner it may be found that purple is the contrasting colour of yellow; blue of orange; violet of a mixture of yellow and orange; and black of white.

"The compounds of these colours will also have their contrasting and harmonizing ones. Thus, purple inclining to red, has for its contrasting colour, yellow inclining to green; purple inclining to blue, has yellow inclining to orange; and so likewise with the other compounds.

"On the other hand, a harmonizing colour will be the nearest tint to the original, but farthest, except the original, from the contrasting colour. Yellow, therefore, is the harmonising colour of white, orange of yellow, red of orange, violet of red, and blue of violet, &c.

"Different shades of the same colour, such as light and dark green, light and dark red, light and dark blue, &c. when they are distant, form, likewise, very bold contrasts; but when the same colour runs through a variety of shades, from a very dark to a very light tint, such tints approach to the nature of harmonizing colours."

In the plan of the work, Mr. Murphy has followed a most excellent arrangement. The construction and use of weaving apparatus are first explained in a most distinct manner, and the plates are such as to convey a clearer idea of the different parts of a loom mounting than we had ever conceived it possible to do by description. Plain cloth and tweeling, in all its varieties, are then fully explained and illustrated by draughts, cordings, or tyes, and patterns; these patterns being done on design or point paper, give an accurate conception of the style and principles of this branch of the art.

Lined work, Dornic and Diaper, occupy a considerable part of his attention, and we think in this he has done right, because they have hitherto been little known beyond the towns where they are practised. He has given a great variety of patterns, which, as the styles may be applied to many branches of fancy-weaving, we consider a most important acquisition to the manufacturer.

Double cloth fabrics, a branch of the art hitherto little applied in the cotton trade, is next treated of in a very full manner. We would recommend those in the shawl trade to study attentively this part of the subject, as we know, from experience, that it may be applied with success in their manufactures, but especially in silks. The principal feature in French silks is the beautiful arrangement of their colours, but we think the theory contained in the extract already given, and illustrated in the work, will enable the manufacturer to compete with them very closely in this respect.

Mr. Murphy has not confined his work merely to fabrics or branches wrought in Scotland. Corduroys, velveteens, and other varieties of that description, are also treated in a manner which, we should think, would render his work very useful in the sister kingdoms; and perhaps the processes of dying these fabrics, which he has given at full length, will be found not less useful to them.

In the branch of Cross-weaving,

the author has been still more extensive in his views. This is a branch of weaving which is yet but little understood, and we were glad to observe that Mr. M. had given it so much of his attention. We have not room, however, at present to do justice to this part of the subject, and we shall therefore defer it till some other opportunity, as well as the branches of spot and harness weaving, with their combinations.

We will conclude by recommending, to those who intend being engaged in the cotton or silk manufactures, to possess themselves of this excellent work; it will be of much greater benefit to them than a few months lessons in a weaver's shop, and the benefit will be obtained at vastly less expense. Very little is gained by a few months apprenticeship, even when a fee is paid, except a knowledge of the technicalities of the trade. This Treatise will, in short, be to the operative a complete Text-Book, to the manufacturer a most useful guide, and to the general reader a very interesting and instructive companion. G.

ON THE STUDY OF BOTANY.

At a season of the year when our native Flora lays aside her graces, it is pleasing to witness the effects which the taste for the study of Botany, and the cultivation of flowers and shrubs, has produced, and, it is to be hoped, will yet more extensively produce, among every class of society. Our Royal Botanic Institution has, no doubt, a considerable share of the honour of producing this taste, and I trust will continue to keep alive, and yet more widely diffuse a relish for this interesting, pleasing, and useful study. Our drawing-rooms, parlours, and, I may add, our workshops and manufactories, are now ornamented with flowers and shrubs from every quarter of the globe. I am often delighted by the beautiful subjects of Flora which are to be seen peeping out at the window of almost every weaver in certain quarters of our city and suburbs; and I confess that I have not been a little surprised that *our intelligent Mechanics*, who have, so much to their honour, formed an association for diffusing a more correct and general knowledge of Chemical, Mechanical, Mathematical, and even Anatomical Science, should not long ere now have added to the number of their teachers a Lecturer on Botany.

It is true we have already two public teachers of the science: our learned University Professor, whose zeal in the pursuit of Botany is only equalled by his talents as a teacher and a writer; and a gentleman,* who, although unconnected with any public or incorporated institution, is well known by his devotedness to the science, and who is entitled to no small share of the honour of extending its boundaries in our city and neighbourhood; and the terms of attendance on his lectures and practical lessons are such as will exclude few who have any wish to become acquainted with the subject. This gentleman, at the commencement of his last Summer's Course, printed, for the use of his pupils, *a short Introduction to the Study of Botany, or a Key to the Linnean System, in the form of a Chart or Tabular Scheme, presenting to the Student a short but at the same time clear and comprehensive view of the science.*

This Key to the Linnean System of Botany is printed on a large sheet, and may be hung up in the count-

* Mr. James Rattray, Surgeon.

ing-house, shop, or study, and tend to keep alive, in the recollection of the student, the principles of the science. This compendium, originally printed for the use of the author's pupils, I am glad to perceive has found its way to the booksellers, and may be had at a price which every mechanic can easily afford to pay.

The interest I take in every subject connected either directly or more remotely with the intellectual, moral, and physical cultivation of our mechanics, has induced me to introduce this subject, and Mr. Rattray's Botanical Chart, to their and your notice.

How much would it not tend to promote the intellectual and physical prowess of our weavers, and that of every other class of artisans, (confined as they are,) to take a Saturday's or a Monday's trip to the hills, glens, and river banks, to collect, and afterwards to arrange and preserve, specimens of our native plants, rather than spend the greater part of these two days, as too many of them do, n the confined and vitiated air of a tap-room?

The Botanical Key may be put in a case, and carried in the pocket; and, with a very few lessons, without any other aid, will soon render the diligent student acquainted with the name and class of every plant he may meet with in his rambles, in the pursuit of health and knowledge. A cheap Flora Scottica, as a companion to the Key, will, it is hoped, soon appear, and Professor Hooker could not render a more acceptable service than by abridging and publishing a cheap edition of his Scottish Flora.

Considering you as bound, by your prospectus, to notice every scientific work which issues from the *Glasgow press*, I have taken the liberty of introducing to your notice Mr. Rattray's Key to the Linnean System of Botany, as well deserving the attention of the student, and by no means unworthy that of more accomplished Botanists.

T. A. B.

SKETCH OF THE HISTORY OF PHILOSOPHY,

Particularly with reference to Mathematical and Mechanical Science.

(Continued from page 252, Vol. II.)

Copernicus was the first who had dared to question the truth of the ancient and common opinion respecting the system of the world, which placed the earth in the centre of the universe. He stands at the head of those men who showed the way to true philosophy, by rejecting an opinion, however sacred, which he found contrary to the evidence of just reasoning and accurate observation. An early and decided taste for the study of astronomy, led him to prosecute his investigations in that science in which he was destined to produce such a complete revolution. The steps by which he was led to the conception of the bold system which removed the earth from the centre of the world, and ascribed to it a twofold motion, must have been extremely interesting; what they were, we cannot now ascertain. It is probable that the complication of so many cycles and epicycles as were necessary to express the law of the planetary motions, according to the Ptolemaic system, had induced him to make all the various suppositions that it was possible to make, to discover a simpler law. The bold saying of Alphonsus, King of Castile, was probably ever present to his memory. This Prince, on being made acquainted with the system of Ptolemy, had dared to say, as is commonly reported, " That if he had been one

of the council of the Supreme, when he made the world, he could have advised how to construct it better." Such a saying, though it cannot be freed from the censure of impiety, shows in a very strong degree the difficulty that the early astronomers had to reconcile the seeming inconsistencies in the ancient system—a difficulty which has been well described by Milton, when alluding to the Almighty:

"He his fabric of the Heavens
Hath left to their disputes, perhaps to move
His laughter at their quaint opinions wide,
Hereafter, when they come to model Heaven
And calculate the Stars; how they will wield
The mighty frame; how build; unbuild; contrive
To save appearances; how gird the sphere
With centric and eccentric scribbled o'er,
Cycle and epicycle, orb in orb."

It is supposed that Copernicus borrowed his idea of the true system from the Pythagoreans, who had veiled it under allegories to prevent the vulgar from attaining a knowledge of such truths. If so, he has as much merit in thus bringing down science to the level of common capacities, as if he had discovered the system itself; locked up in the mysteries of ancient allusions, it was as useless to the mass of society, as if it had been wholly unknown, and he who unfolded the sublime truth in common language, deserves the sincerest gratitude of the race. The work which contained the explanation of his system, was published only a few days before his death; and what is remarkable, the publication was earnestly solicited by a Cardinal, and the book itself was dedicated to the Pope. How different was the conduct of the dignitaries of the Romish Church afterwards! In this work he had promulgated the doctrine of the earth's motion with great caution, as if he had been gifted with a presentiment of that opposition which it was one day to experience. At first, the doctrine attracted so little attention, that the greater part of his cotemporaries rejected it as absurd, and it lay fermenting in secret for half a century, till, by the exertions and the fame of Galileo, it was kindled into so bright a flame, as to consume the philosophy of Aristotle, alarm the Hierarchy of Rome, and threaten the destruction of every opinion that had descended from antiquity. The bold and exuberant imagination of Kepler, working on the accurate observations of Tycho Brahe, (who was prevented by religious scruples from adopting the Copernican System,) and aided by the most persevering industry and intense labour in calculating and combining these observations in every possible form, at last drew aside the veil, and disclosed to our view those eternal laws which govern the revolutions of the heavenly bodies.*

The noble army of scientific men, was now rapidly increasing. The genius of a Galileo had discovered and applied the elementary principles of motion, and the theory of falling bodies; he re-invented and re-constructed the telescope, which had been discovered in Holland. This truly wonderful instrument he directed to the heavens, and observed the varying phases of the planets, and discovered the harmony of new worlds. It was then that, as Milton says,

"A broad and ample road whose dust is gold,
And pavement stars, as stars to thee appear,
Seen in the galaxy that milky way,
Which nightly, as a circling zone thou seest,
Powdered with stars;"

was discovered to be a truth unknown to the ancients. Such extended views of the mechanism of the heavens, could not fail to delight and to astonish mankind, and raise them far above the grovelling ideas which they had formerly entertained of the power, the wisdom, and the goodness of the Author of Nature.

(To be continued.)

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* For a more full and interesting account of the discoveries of this wonderful genius, see Nos. 24 and 25, Vol. I.

NEW MECHANICAL MODE OF ASCERTAINING THE EXTENT OF ANY COUNTRY.

SIR,—Among many interesting articles in your very ingenious Magazine, my attention has been particularly attracted to one in No. XXXIV. Vol. II. of the 21st August last, on *the Contents of the different Counties of Scotland*, as ascertained by Mr. Jardine and Sir George Stewart Mackenzie.—*See page* 74, *Vol. II.*

On the same subject, I myself, some years ago, made an estimate, and though, by a different mode of operation, the difference in the result has not been remarkably great, as it amounts to only 137 square miles in all, which is less than one-half of a per cent. which, when the extent of the subject is considered, the thirty-three counties of Scotland, with all their numerous indentings and islands, is a strong evidence of the general accuracy of both methods, though conducted on different principles.

The mode adopted by the gentlemen mentioned, was, by cutting out, from Arrowsmith's great map of Scotland, every county by itself, and then comparing the weight of each portion so detached, with another portion of a regular form, taken from the same map; and thus the contents of each was ascertained. This is similar to the method adopted by the late Bishop of Landaff, (Dr. Watson,) as stated in "Preliminary Observations to the General View of the Agriculture of Westmoreland, by Andrew Pringle, in 1794." If dependence could be put on the exact uniformity in the texture of the paper, and on the minute accuracy of the balance employed, this mode of ascertaining by weight, is perhaps one of the best that could be devised.

My plan, however, was different, and it was adopted, not from any want of confidence in the other, but *from an aversion* to the operation of cutting up and destroying my copy of the map, which cost me three guineas and a half. *I covered the map, county by county, with tin plates.* Having ascertained that the map was on a scale of four miles to the inch, thus comprehending sixteen square miles in the compass of a square inch, (or 10,240 English acres,) I caused a number of pieces of tin plate, (or white iron,) to be accurately cut, into aliquot parts of an inch, for the purpose. Thus, I had one piece of four inches square = 16 square inches, or 163,840 acres; one piece of three inches square = 9 square inches, or 92,160 acres; several pieces of two inches square, each = to 4 square inches, or 40,960 acres; a great many of one inch square = 10,240 acres; many also of half an inch square = 2560 acres; a still greater number of one-fourth of an inch square = equal each to 640; and of one-eighth of an inch = 160 acres; and one-sixteenth of an inch = 40 acres; which was the least size that I found it practicable to handle. These smaller pieces were applied to fill up the holes and corners in the irregular outlines of the counties. To make them more applicable, I had a considerable number of the smaller kind cut diagonally, the more readily to suit the shape, while some of the eighth parts were cut lengthwise, in inches, half inches, and quarter inches, to afford the greater facility in the arrangement. The whole of this simple apparatus, together with a box to hold it, cost me fifteen pence.

When I had, in this manner, covered an entire county, or an entire island, I removed the whole into a place by themselves; and then added them up, as so many tallies, each kind according to its value, till I found the whole; and then proceeded to a new subject.

It required great attention, and no little time, but there was no intricacy in the operation. The following Table gives the result, which, as a matter of curiosity at least, may be compared with the Table alluded to in page 75, Vol. II. or in No. XXXIV. of your Magazine. I have to add, that the Orkney and Zetland Islands, not being in Arrowsmith's map, were ascertained from Donnelly's Nautical Map, published in 1797, on a scale of ten geographical miles to the inch. The lakes, in these islands, were roughly calculated from the Statistical Account of the Parishes, Edmeston's History of Zetland, and other authorities.

TABLE *of the Extent of the different Counties in Scotland.*

Names of Counties, &c.	Square Miles of Land.	English Acres of Land.	Square Miles of Fresh Water Lakes.	English Acres of Lakes.	Total Square Miles.	Total English Acres.
Aberdeen,...............	1960	1,254,400	10	6,400	1970	1,260,800
Argyle, Mainland,...	2200	1,408,000	60	38,400	2260	1,446,400
Ayr, ...	1039	664,960	6	3,840	1045	668,800
Banff, ...	645	412,800	2	1,280	647	414,080
Berwick,..............	442	282,880	—	——	442	282,880
Caithness, ...	687	439,680	10	6,400	697	446,080
Clackmannan, ...	48	30,720	—	——	48	30,720
Cromarty,.............	256	163,840	10	6,400	266	170,240
Dumbarton,...........	228	145,920	31	19,840	259	165,760
Dumfries,..............	1253	801,920	10	6,400	1263	808,320
Edinburgh,............	354	226,560	—	——	354	226,560
Elgin, ...	473	302,720	7	4,480	480	307,200
Fife, ...	467	298,880	3	1,920	470	300,800
Forfar, ...	888	568,320	4	2,560	892	570,880
Haddington,...........	272	174,080	—	——	272	174,080
Inverness, Mainland,	2904	1,858,560	132	84,480	3026	1,943,040
Kincardine, ...	380	243,200	2	1,280	382	244,480
Kinross, ...	72	46,800	7	4,480	79	50,560
Kirkcudbright, ...	821½	525,760	12½	8,020	824	553,780
Lanark,................	942	602,880	3	1,920	945	604,800
Linlithgow, ...	120	76,800	—	——	120	76,800
Nairn,..................	195	124,800	3	1,920	198	126,720
Peebles, ...	319	204,160	—	——	319	204,160
Perth,..................	2588	1,656,320	50	32,000	2638	1,688,320
Renfrew,...............	225	144,000	2	1,280	227	145,280
Ross, Mainland,......	2069	1,324,160	60	38,400	2129	1,362,560
Roxburgh,.............	715	457,600	½	320	715½	457,920
Selkirk, ...	263	168,320	1½	960	264½	169,280
Stirling, ...	489	312,960	13	8,320	502	321,280
Sutherland,............	1754	1,122,560	47	30,080	1801	1,153,360
Wigton,................	451½	288,960	7½	4,800	459	293,760
Total, Mainland,.....	25,520	16,322,800	494	306,160	26,014	16,648,960
Bute and its Islands,	161	103,040	4	2,560	165	105,600
Orkney, ...	425	272,000	15	9,600	440	281,600
Zetland, ...	855	547,200	25	16,000	880	563,200
Argyle Islands, ...	929	594,560	21	13,440	950	608,000
Inverness Islands, ...	1150	736,000	59	37,760	1209	773,760
Ross Islands, ...	560	358,400	20	13,800	580	371,200
Total Islands,.........	4080	2,611,200	144	92,160	4224	2,703,360
Total of Scotland,....	29,600	18,934,000	638	408,320	30,238	19,352,320

The preceding Table, too, is the same with that which is inserted in Sir John Sinclair's General Report of Scotland, Vol. I. page 13, only with this difference, that there the whole estimate is by square miles, whilst here English acres also are added, to compare it the more readily with the Table in your Number XXXIV.

GEO. ROBERTSON.

Bower Lodge, 2d Nov. 1824.

ON A MAGNETICAL INSTRUMENT FOR DETERMINING THE LONGITUDE BY INSPECTION.

MR. EDITOR,—I met lately with a short notice of a magnetical instrument for determining the longitude by simple inspection, said to have been invented a few years ago by Mr. Benjamin Wood, of Liverpool, which, if it really possesses this property, must surely be of great service to navigators.

As far as I recollect, the account of it stated that the inventor had been much employed in fitting up compasses, and in preparing magnetic needles for them; and that, after adjusting the bar and the card to the plane of the horizon, he found, on *touching* the former, that it not only *dipped* towards the north, but likewise invariably *inclined to one side*. In the course of some experiments on this subject, he prepared a cylindrical bar, which he adjusted so nicely between two centres of agate, that it whirled round with great freedom, and rested indifferently in any position whatever; but, on being *magnetised*, it turned with a certain part upward, and obstinately maintained that position when at rest. On this cylindrical magnet, about a quarter of an inch in diameter, he placed a kind of wheel of brass, graduated at the edge into 360 degrees. Of this wheel, which might be two or three inches in diameter, the magnet formed the axis. The bar, with its wheel, he fixed in a brass frame, and balanced the frame upon an agate centre, whereby the magnet readily assumed its former position, that is, its parallelism to the magnetic meridian. His whole apparatus he placed in charge of an American captain, for the purpose of trying the effect, in crossing the Atlantic, of its use in determining the longitude, which it seems it did most perfectly, accurately showing the longitude all the way across, by turning a different degree upward for every degree of longitude passed over; thus constantly maintaining its vertical, as well as its horizontal parallelism.

As this is certainly something new, at least to me, I should be much obliged to you, or any of your intelligent Correspondents, for some information concerning it; as I should like to know, whether this new property of the magnet has been satisfactorily established by a sufficient number of trials.

I am, SIR, your's, &c.

D.

ON THE STRUCTURE OF MATTER.

MATTER is an abstract and generic term, of which the only description we can give, is, that it is used to denote the unknown *substratum* of all bodies. In Philosophy it may be defined to be a substance, the object of our senses, in which are always united the following properties: *extension, figure, solidity, mobility, divisibility, gravity,* and *inactivity*; or, whatever is extended and capable of making resistance; and if this definition be admitted, it cannot be denied, that all bodies, whether solids or fluids, are material, and made up of matter, since all bodies, fluids as well as solids, are extended and do resist.

That matter is one and the same thing in all bodies, and that the vast variety

observable, arises solely from the various forms it assumes, appears very probable. This position has, however, been strenuously opposed by persons maintaining that matter is heterogeneous, or of various kinds, and that in the creation of the universe, various principles were formed at one and the same time, and, consequently, that all the elements of bodies are so many distinct and particular works of the Supreme Being. Among the advocates for several elements, the Peripatetics took the lead, who contended that fire, air, water, and earth, were four distinct elements, which made up matter. Those on the other side, contend that all matter is homogeneous, or of one kind, and assert, that, in the beginning, the Author of the universe created only one universal matter, and that the different bodies were the results of the different combinations to which he afterwards subjected them. This dispute is an idle one, as at best our information on this subject cannot be very definite. It is easy enough to form hypotheses on subjects of this nature, but a better and a safer mode is not to be too presumptuous in this way with regard to subjects which it may be beyond our powers to understand in any way, except partially.

Various opinions have been entertained on the subject of matter by different philosophers, some of whom have carried their speculations so far as to end in arguing against the existence of matter itself; as the Bishop of Cloyne, who labours to prove that matter does not exist, except in the mind. His hypotheses respecting the nature and essential properties of matter are highly ingenious; and did the limits of a short sketch like the present admit of it, an account of them might not be improper.

The particles constituting matter are not in absolute contact; that is, they touch each other without cutting or entering, and have their surfaces joined to each other without any interstice. Many circumstances concur in giving weight to this assertion. Among the principal of these, is the existence of small interstices, called *Pores*, betwixt the solid particles of matter. These we are certain do exist, from the fact, that bodies when heated, expand, and when they become cold, contract. In solids, Porosity is more visible than in fluids. The vacuity in the former is actually seen; in the latter, it requires to be proved by experiments. *In neither* are we able to estimate with perfect exactness the vacuity, although it is certain, that even in the densest bodies, the quantity of solid matter is much less than that of empty space. This being ascertained, is enough of itself to prove that the particles of matter can only touch one another in a few points. But there are other circumstances which clearly prove this to be the case. Many bodies possess a high degree of elasticity, or the power of restoring themselves to their former figure after any external pressure; and this is a power common to solid and fluid bodies. A body which is perfectly elastic has a tendency to restore itself to its former position with the same force by which it was turned from it; exerting its force equally on all sides, but producing the principal effects where it meets with least resistance. This property has been the subject of much inquiry among philosophers, who have advanced various hypotheses to account for it. It is most generally supposed to arise from the presence of Caloric, and the attractive and repulsive powers that have place between the minute particles which constitute a body, whether it be a solid or a fluid.

As we stated above, all bodies are subject by expansion and contraction, to change their magnitude, according to certain laws, and under certain limitations. The same thing takes place in certain mixtures of bodies of different natures; for, in many cases of this kind, a loss of bulk actually takes place. If a cubic inch of any body be mixed with a like quantity of a body of a different kind, the bulk of the mixture will not amount to two cubic inches; yet the weight of the mixture (if evaporation has not taken place) will be equal to the sum of the weights of the two fluids, which proves that one of the fluids must have filled up some of the pores of the other fluid.

From all these circumstances, we must infer that there exists a power, called Corpuscular Attraction of Cohesion, by which the minute component particles of bodies are united, and do adhere to one another; (distinguished into attraction of aggregation, viz. that power by which the homogeneous particles of bodies are united; and attraction of affinity, by which the heterogeneous particles of bodies are united;) and also a power denominated Repulsion, by which bodies placed just beyond the sphere of each other's Attraction of Cohesion, mutually recede and fly off.

D.

REPORT OF THE MATHEMATICAL CLASS, ANDERSON'S INSTITUTION, And of MR. WALLACE'S Concluding Address.

THIS Report and Address were delivered nearly in the following words: I shall now conclude the Course by a short review of the subjects which have been laid before you, of the uses to which they may and have been applied, and of the future progress in science to which they will lead, if successfully pursued. The Course commenced with an explanation of the rationale of the elementary rules of Arithmetic, and of some of their applications. This method being new, seemed to interest all; attention was roused by the discovery, that many things, which had been formerly taken for granted, could be easily and satisfactorily explained; and that, even in what are called the four common rules, something might be learned which was unknown before. As these rules were successively explained, several elucidations seemed new to many who flattered themselves they understood them well. Other methods of performing the operations were shown, sometimes shorter, and sometimes longer and more explanatory of the nature of the science. Napier's rods or bones were explained, and many beautiful and simple methods of contracting operations were illustrated. The nature of Fractions, both vulgar and decimal, was explained by a reference to lines and other sensible objects, and the reason of the rules laid before you. The Doctrine of Proportion was explained in a manner quite different from what is usually delivered in books on Arithmetic, and the mode of explanation which was adopted was considered more satisfactory than the common mode. This was only to be expected, inasmuch as it proceeded on a principle which must be assumed as an axiom in all the sciences, "that like things can only be compared with like;" a principle which is overlooked in ninety-nine hundredths of the works which treat on the subject. The nature of Roots and Powers, with reference to numbers, was explained, and I am convinced was well understood.

This led us naturally to Algebra, which always occupied one night in the week. A new set of definitions were framed and laid before you. The object of this science was stated to be the construction and resolution of Equations. The general rule for obtaining an equation from the terms of any question, was enounced immediately after the definitions. This enunciation was of the greatest use, it fixed your ideas respecting the nature and use of the science, and it was constantly kept in mind. The common rules of Algebra were then explained, in succession; and, at the end of each rule, equations, immediately solvable by that rule, and the simplest axioms of the science, were submitted to your consideration, were explained, and were understood, in so satisfactory a manner, that I had the pleasure of receiving solutions of many equations, which are generally considered far beyond the compass of the ordinary rules, from some of the youngest of the class, and from those who never studied the science all their lives before. The rules for the resolution of equations were deduced immediately from the common rules of operation. Thus, the rules for Transposition, and Changing of Signs, were deduced from Addition and Subtraction; that for Clearing of Factors and Divisors from Multiplication and Division; and in this way, long before the student had been bewildered by the more intricate parts of the science, or had missed his way in "wandering mazes lost," he was enabled to solve the more easy and useful questions which occur in Algebra.

The nature of Algebraic Fractions next attracted your attention; you were shown how to treat them exactly in the same way as Arithmetical Fractions, making only allowance for the difference in the mode of operating on quantity. The method of Clearing Equations of Fractions was then deduced from those rules, and the application of it shown in several problems. The Doctrine of Involution and Evolution was then illustrated, and Sir Isaac Newton's Binomial Theorem demonstrated in a new and easy manner from the simplest principles of the science; its application to the raising of powers and extracting of roots was exhibited and explained; and I have the satisfaction of saying that even this great effort of Newton's genius was understood and applied by the youngest student. The rules for freeing equations of surds and powers were then deduced and applied. The rules of Arithmetical and Geometrical Progression have been demonstrated and illustrated;

and, from what we have accomplished this evening, the same may be affirmed of the rules of Simple Equations for any number of unknown quantities, as well as Quadratic Equations. Here, of course, our Algebraic labours must terminate, and I feel the greatest satisfaction in having had it in my power, notwithstanding the shortness of the Session, (which consisted only of about two months and a half,) to be able to lay so much of this interesting science before you.

If we look to our Geometrical labours, on another evening of the week, we shall find they have been no less successful. We have carefully demonstrated and studied the forty-eight propositions of the First Book of Euclid. Some improvements, even in his excellent definitions, were made; the whole were rendered plainer, and the real meaning of every term was explained. The enunciations were shortened, and in every case rendered more distinct. The constructions were simplified, and the demonstrations curtailed, while all their strictness, which has preserved them immaculate for 2000 years, was preserved. By this means they were rendered less irksome to the student, and he was insensibly led to admire the beauty of the science. The most useful and important corrollaries, both scientific and practical, were deduced from the propositions as you advanced, and the various short and practical methods of performing the problems were exhibited. From the 13th proposition and its corrollaries, we deduced the division of the circle and the measure of angles; from the 32d we deduced the measure of all the angles of a triangle, and laid the foundation of Trigonometry; from the 41st we deduced the areas of parallelograms and triangles, laid the foundation of Mensuration and Landsurveying, and showed the easiest method of measuring fields. From the famous 47th we deduced a variety of fine problems respecting squares, and laid the foundation for the Trigonometrical Canon. The finest propositions of the Second Book of the Elements were next brought before you, and demonstrated in the simplest manner. The properties of the circle in the Third Book were then successively developed, and from the 37th proposition we deduced the following simple rule for determining the limits of the visible horizon from the top of any eminence on the surface of the earth, knowing its height above the level of the sea, viz.: "*If to the height of the eye of an observer, above the level of the sea, (given in feet,) its half be added, and the square root of the sum be extracted, the result will be the limit of the visible horizon in miles, or the farther point one can see on the surface of the earth at sea-level.*"

The various new Geometrical propositions, both problems and theorems, which were from time to time proposed to you for solution and demonstration, gave me the most satisfying and pleasing proof from the manner in which they were executed, that many of you fully understood this sublime science so far as we had advanced in it. My only wish therefore is, that you will be stimulated by this cheering success which has attended your exertions, to make farther advances, assured that your labours will ultimately bring their own reward in the vast superiority they will give you over your fellow-men. You alone will then be considered as fit for the most important situations, your talents will command them, and will bring along with them that comfort, respectability, and competency, which is justly due to the industrious.

Our labours on the remaining night of the week have been more varied. They have been directed to the examinations of the Candidates for the premiums, the solutions of difficulties, and the applications of the rules of science to practical results. The nature and use of Logarithms have been illustrated and explained. Their application to arithmetical and trigonometrical operations was exhibited. The Science of Trigonometry itself was so far elucidated. The mensuration of heights and distances has been illustrated. The method of taking vertical and horizontal angles, by means of the quadrant, sextant, reflecting circle, and other instruments, was explained, as well as the nature and construction of these instruments, by a reference to the laws of incidence and reflection. The instruments themselves were exhibited, by which the altitude of the sun, or a star, the angular distance of the sun and moon or a star, could be taken, by which a field could be surveyed and measured, an estate calculated or laid out, or the extent and dimensions of an enemy's camp ascertained; by which, in short, the height and distance of a mountain could be measured; a whole country accurately sur-

made very considerable advances in Geometrical science. Another who could not conceive what Mathematics were, and could find nobody to tell him, has surpassed most of his competitors. Several volunteers who had studied before, actuated by an honourable feeling retired from the competition. This fact not being known at the time, might operate as a damp upon others, and prevent them from coming so boldly forward towards the end of the course, as they did at the beginning. Several being unacquainted with the nature of the examinations which were to be instituted, and being actuated by diffidence respecting their own abilities, seldom came forward so regularly as might have been expected. The same cause operated in preventing the competition for the third prize which was offered, from taking place. I respect this feeling; it is national, and it does honour to the nation; but there are cases, and this I think is one, where natural diffidence ought to be overcome, and where it may be overcome without verging into an opposite feeling. This is only a first course, however, and a very short one; and it is to be expected that greater efforts will be made in future.

If ever it shall be my lot to deliver to you a course of lectures again, I trust to have it more in my power to render them still more interesting, by a variety of MECHANICAL EXPEDIENTS AND ILLUSTRATIONS, which it was impossible to get forward in time for this course, owing to the great advance of the season before it occurred to institute the lectures. I cannot conclude without again expressing my gratitude for the kindness and attention which you have uniformly expressed, and I shall feel the greatest pleasure, if circumstances hereafter should occur to bring us together, for the purposes which have occupied our attention this session, in contributing to your advancement in scientific knowledge and its practical applications. With every wish for your future welfare and prosperity, Mathematicians! farewell.

The premiums offered to the competitors, were awarded in the following manner:—

For excelling in the Geometrical Exercises, a silver medal and suitable inscription, to

Mr. GEORGE WHITELAW.

For excelling in the Algebraical Exercises, a silver medal and suitable inscription, to

Mr. WILLIAM GARDNER, Jun.

For merit in both kinds of Exercises, a third and fourth prize, with suitable inscriptions, to

Mr. JAMES M'EWAN, and
Mr. DAVID BOWMAN.

[*A few of the Exercises will be given in our next.*]

QUERIES.

What is the best method of regilding picture frames?—D.

In St. Vincent-Street, several Nos. (for instance, 37 and 9) occur twice.* To one of these double Nos. a porter was sent with a hare; and finding the given No., delivered his charge; but not far distant was the other house bearing the same No.; and the proper owner discovering the mistake, sent for the hare, when, lo! there remained little but the *hair*. Is a porter, in such a case, culpable? and should not the street be properly numbered?

L. M'L.

* In London, a person was on the point of losing a friend, on whom he called, owing to the door of his house being one of three which belonged to different establishments, but were all marked with the same number, and were contiguous to each other.

NOTICES TO CORRESPONDENTS.

J. M., G. S., W. S., M. A., L. M'L., J. A., &c. &c. have been received.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, and Original Patents, Inventions, &c. will be inserted on the shortest notice.

Published every Saturday, by W. R. M'PHUN, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of STEUART & PANTON, Cheapside, London; and EDWARD WEST & Co. Edinburgh.

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THE GLASGOW MECHANICS' MAGAZINE.

"Three things bear mighty sway with men,
The sword, the sceptre, and the pen."

No. XLVII. *Saturday, 20th November,* 1824. Price 3*d.*

THE PTEROENTOPLOION, OR BOAT WITH WINGS.

INVENTED BY MR. DIXON VALLANS.

MR. EDITOR,—It is with pleasure that I have read your excellent Magazine; and I thus express my sentiments in the language of an eminent poet:

"Now, lo! the sons of Genius stand,
And Science open spreads her volume fair,
And Friendship waves her hand,
To check the child of mirth, to soothe the child of care.
Lo! Science comes and takes her awful seat,
While Genius glides along, her queen's advance to greet.
Mark how th' attentive votaries throng
Where she her genuine love imparts,
And catch from her inspiring tongue
The thirst of praise, the love of Arts.
As she unveils the brighter day,
The shades of error melt away.
A transport this superior far
To all the bliss th' exulting conqueror feels,
When crowds, triumphant, hail him from the war,
And conquered nations crouch beneath his wheels."
Roscoe.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

DESCRIPTION OF THE PTEROENTOPLOION, OR A BOAT WITH WINGS.

INVENTED BY MR. DIXON VALLANS.

With wings so fitted to each side,
Through briny waves I swiftly glide,
And run against both wind and tide
And never tire;
And in the water dive and hide,
If need require.
Impelled by steam's all-conquering power,
I'll run at eighteen knots per hour.
Dixon Vallans.

I TAKE the liberty of laying before you a contrivance of mine, for propelling boats of every description. The boat is fitted with wings jointed to each side, and is put in motion by turning a crank; and, if required, it will run below the surface of the water—as is seen by fig. 5th. I made a model of a boat as I have here represented, and tried it both with wings and paddle wheels, and it went three times across a pond with the wings, in the time that it took to cross it once with the paddle wheels. Boats played with paddle wheels require an enormous power to impel them, there being such a weight of water to lift on the back part of the wheel, which greatly retards the forward motion of the vessel, and makes her go heavily.

As this plan for propelling boats will be found to be of great utility, I hope you will find an early place for it in your valuable work; and in so doing, you will oblige your's, a Mechanic,

Dixon Vallans.

Libberton, Lanarkshire, Oct. 7th, 1824.

Description of the Figures.

Fig. 1st is a flat or horizontal view of the boat. A A the crank. B B the wings. C C the arms, which have moving joints. D D the shafts, which give motion from the crank to the wings. E E E E is the leaves or feathers of the wings, which, by the forward motion of the crank, folds nearly close to the wing; and by the backward motion folds back, and forms a strong pressure against the water; and by that means impels the boat forward with great velocity. The feathers may be either of hard wood or sheet-iron, six or eight inches broad, and one foot six inches or two feet long; or they may be made any size, according to the size of the vessel.

Fig. 2d is a side-view of the boat, with the wings in the act of pressure against the water.

Fig. 3d is a side-view of the boat, with the wings sliding on rods, in place of arms.

Fig. 4th represents a wing sliding on iron rods in the act of going forward.

Fig 5th shows the boat running under water. F is an air pipe. G G G G wooden pipes, which are supported from the boat, and keep her a certain distance below water. She has a pair of broad wings, which, when folded out, raises her to the surface of the water. This boat is only used on secret expeditions.

Fig. 6th represents the wing.

Fig. 7th is a feather of the wing. The feathers are made concave on the side that presses against the water, the other side being round. Wings may be fitted to a boat for far less expense than paddle wheels, and will be found to answer the end three times better.

D. V.

SOLUTIONS AND QUERIES.

SCALE QUERIES SOLVED.

(See page 190, Vol. II.)

1. As 8 is the index of the given scale, therefore

$$\begin{array}{r} 4 \times 1 = 4 \\ 3 \times 8 = 24 \\ 5 \times 8 \times 8 = 320 \\ 2 \times 8 \times 8 \times 8 = 1024 \\ \hline 1372 \end{array}$$

By placing 1 as a denominator, it will be the fraction required, or $\frac{1372}{1}$, in the denary scale.—G. S.

2. To reduce 5765, in the common or denary scale, to the scale of $3\frac{1}{2}$. This is done by continually dividing the given number by the index, or root of the given scale; the different remainders, and the last quotient, is the number required.

$$\begin{array}{r|l} 3\frac{1}{2})5765 & \\ 3\frac{1}{2})\overline{1647} & \frac{1}{2} \\ 3\frac{1}{2})\overline{470} & 2 \\ 3\frac{1}{2})\overline{134} & 1 \\ 3\frac{1}{2})\overline{38} & 1 \\ 3\frac{1}{2})\overline{10} & 3 \\ 2 & 3 \end{array}$$

Therefore $233112\frac{1}{2}$ is the number required.—G. S.

TREE QUERY SOLVED.

(See page 190, Vol. II.)

As it is the frustum of a cone, the whole length of it may be found. Thus, as the difference between the semi-diameter is to the length, so is the semi-diameter of the largest end to the whole length. That is, 1 : 24 : : 2 : 48. The whole solidity will be $4^2 \times .7854 \times \frac{48}{3} = 201.0624$. The solidity of the frustum will be $\frac{4^3 - 2^3}{4 - 2} \times .7854 \times \frac{24}{3} = 175.9296$; its half $= 87.9648 =$ the solidity of the section to be cut off. Also, $201.0624 - 87.9648 = 113.0976 =$ solidity of the remaining part of the cone. Therefore, to find its length, $201.0624 : \overset{3}{48} : : 113.0976 : 62208$, and $\sqrt[3]{62208} = 39.62$. Therefore $48 - 39.62 = 8.38 =$ distance from the larger diameter of the tree where it is to be cut.—G. S.

QUERIES.

CASK OF WINE.

1. A gentleman had a favourite cask of wine, which contained 120 gallons; it happened to please the palate of his butler, who drew off a bottle every time he went to the cellar, and supplied its place with the same quantity of water; he continued thus visiting the cellar, and robbing the cask, every day for three months, or ninety days, before he was discovered. How much wine then remained in the cask, allowing five bottles to a gallon?—G. S.

POPULATION.

2. The population of the seven South American States, (Mexico, Columbia, Buenos Ayres, Guatimala, Peru, Chili, and Brazil,) in 1823, was 21,185,000, and their extent, in square leagues of 20 to a degree, 623,840; I demand in what time their comparative population will equal that of Scotland, or one to every nine acres; allowing them to increase their number by $\frac{1}{20}$ of their number yearly?—G. S.

FIELD.

3. A triangular field, whose three sides are 2352, 2184, and 2520 yards, is to be divided into three isosceles triangles, in each of which

a square is to be inscribed, what is the area of each square in Scotch acres?—G. S.

ST. CRISPIN.

4. Can any of your Correspondents inform me who St. Crispin was, the reason of his canonization, and an explanation of the mock pageant, exhibited on the day kept as his anniversary?—G. S.

TUB QUERY SOLVED.

Put $x =$ the top diameter; then $x + 11 =$ the bottom diameter; then to find the content, $(x + 11)^2 + x^2 + x \times (x + 11) = 3x^2 + 33x + 121$; this, multiplied by .78539816339, and by $\frac{1}{3}\sqrt{x^2 + 11x}$ the height, gives the solidity of the frustum. This expression is reduced to $(x^2 + 11x + 40\frac{1}{3})\sqrt{x^2 + 11x} = \frac{\text{solidity}}{.78539816}$; now, to find this solidity, put $y =$ to it; then $\frac{y}{231} - \frac{y}{282} = 17.344788$ per question; this reduced, gives $51y = 1129874,179896$; and, dividing by 51, gives $y = 22154,395684$ the true solidity of the tub: this, divided by .78539816, gives $28207.85267 = (x^2 + 11x + 40\frac{1}{3})\sqrt{x^2 + 11x}$ which, resolved by the common mode of approximation, gives $x = 24,999274$, and from this I conjecture, that 25 and 36 are the two diameters meant by the proposer; these give 30 for the depth of the vessel, the mean proportional being $\sqrt{25 \times 36} = \sqrt{900} = 30$.—Rusticus.

PLAN FOR EXTINGUISHING FIRE & PROTECTING BUILDINGS.

Mr. Editor,—I have often been surprised that the following easy method of protecting property against the ravages of fire, has never been attempted by any of our mill-builders, while a heavy expense is incurred to render the fabric incombustible. Besides, by the plan of iron-beaming and roofing, and brick-flooring, the building becomes of such immense weight, that a failure in the strength of one beam, may crush the whole of the building, machinery, and inmates in a moment, of which the late disaster in Manchester is a lamentable instance.

The method I propose is to furnish the mill with a cast metal tube upon the outside of the building, standing perpendicularly, reaching to the top of the wall, and acting as a forcing pump; to supply this pump with water from the mill-lade or from the tank of a steam mill, and to connect it with the moving *power of the mill* by a piece of machinery, which may be dashed on in a moment and force a supply of water to the top of the building.

At the first storey, let a platform project from the wall around the forcing pump, upon which a man can stand with safety. At about four feet above the platform, let a short tube jut out from the forcing pump, pointing to the interior of the mill, and communicating therewith by an opening in the wall: upon this jutting tube, tie on a short leather tube with a metal ring in its nozzle: this may be called the ejection tube. The forcing barrel should also have a stop-cock above the ejection pipe, to prevent the water rising any higher if it is not wanted. Now, if any fire shall take place in that flat, the apparatus is connected with the moving power, a man mounts the platform, shuts the cock above, and directs the ejection pipe to any part of the flat he chooses; or he dashes the jet of water upon the ceiling above, breaks

it into drops, and soon inundates the whole floor, which should have a fillet of two or three inches thickness at the top of the stair, and at all openings therein, so that it may hold the same thickness of water; and the wall should have an opening and a trough to convey the water back to the tank.

Each of the succeeding stories should be furnished in the same manner, with the platforms directly above one another, to afford protection against loose materials falling upon the man at the pump. If the water is wanted in the second storey, open the ejection pipe and cock below, shut the cock above, and direct the ejection pipe to where it is wanted.

To complete the security, it will be necessary to employ some trusty old servant to walk about the premises all night and give the alarm; the apparatus being all in readiness, a very serious fire may be suppressed in a few minutes, without the confusion and destruction of property which is always attendant upon alarm of fire. It is the prompt application of the remedy that is the secret of fire-extinguishing; a single pail of water will extinguish a fire that baffles a fire-engine, before it can be put to work.

Sir, I presume that if the above apparatus was well constructed and kept in good order, it might supersede, or at least diminish the expense of insurances, which is a heavy item upon manufacturing industry. It would be presumption in me, and an insult upon the genius of Glasgow, to enter more into detail; if the principle is suggested, all the minutiæ of its construction is at a call among your mechanics.

W. S.

ON THE CURE AND PREVENTION OF SMOKE.

SIR,—In No. XLIV. Vol. II. of your Magazine, Z. proposes two queries concerning smoke and old wives, to which the following may be considered an answer.

Back smoke is caused by vents having a back draught when there is no fire; they consequently draw down a part of the smoke of the other vents on the same stalk, according as the wind blows. Sometimes it arises from a communication between two or more vents below the top. Now, it is evident that old wives, if they move freely with the wind, must prevent the smoke from coming down where it arises from the first cause. When it arises from the second cause, it is prevented by stopping up the communication, if it be practicable. Where this cannot be done, smoke dispersers will be found a pretty certain cure, as they tend to increase the draught. For the same reason, smoke dispersers will be found a better remedy for vents of weak draughts than old wives.—Register grates are the best cure, when people are furnishing new grates.

If this appears in your Magazine, I will send you an improved plan for the construction of old wives and smoke dispersers, which, if it be known, has not been generally followed.

I am, SIR, your's, &c.

Y. S. D.

Gorbals, Nov. 16th, 1824.

R. of Port-Glasgow states "that old wives, *alias* smoke-preventers, *alias* iron funnels, having a top or vane revolving round a spindle with the wind, completely answer their intended purpose, that every kind of earthen can is of little or no avail, and that the former is also a preventive of back smoke."

PLAN OF A USEFUL SET OF TABLES.

Mr. Editor,—Would some of your scientific Correspondents inform me, through the medium of your useful Magazine, whether there are any calculated tables in print, showing the respective and relative powers of steam and water. If no such tables have been published, I would suggest that such might be advantageously prepared, and printed in the form of a small pamphlet; and I am persuaded, that if they were executed upon correct, scientific, and practical principles, that they would meet with a ready and extensive sale. I would recommend that they be arranged in two distinct branches;—the *first* to contain in the left hand column, the whole range of the diameters of steam cylinders, from the smallest to the largest size, set down in inches; and opposite to each diameter, on the right hand, let there be set down, according to the most approved standard calculation, the number of horses power that each of these diameters will give, upon a double powered patent steam engine of the most approved construction, thus;—

Steam Power.

Diameter of Cylinder in Inches.	Horses Power.

And, *secondly*, let there be a number of tables prepared upon the plan of an Interest Table book, and let these tables be titled on the top of each, thus: "Fall of 5 feet," "Fall of 10 feet," "Fall of 20 feet," and so forth, so as to embrace all the falls that are or might be applied to mechanical purposes in this country; then along the left hand side of each of these tables, let the quantity of water that would pass through the sluice, be laid down in square feet, beginning with the highest number of square feet, and ending with one foot, so as to include the whole falls in this country; and opposite to each on the right hand, let the horses power be extended in three columns, as operating upon an overshot, breast, or undershot wheel respectively. Example:

Water Power.

FALL OF — FEET.			
Square Feet of Water.	HORSES POWER.		
	Overshot Wheel.	Breast Wheel.	Undershot Wheel.

Were such tables published, any person might, at a single glance, be able to resolve the following, or any similar question, *viz.*: Suppose a waterfall of 15 feet high, yielding a constant and regular supply of 9 square feet of water through a sluice; what number of horses power would such a fall produce, by means of an overshot water-wheel of the most approved kind?

I believe the height and breadth of the water-wheels would require to be taken into account, but these matters are best known to the practical engineer.

Were a prospectus of the work to be published under the inspection and superintendence of some well known practical and experienc-

ed engineer, I am certain that there would scarcely be an engineer, cotton-spinner, or other mechanic in Great Britain, who would not wish to be possessed of a copy. "Roberts's Mechanics' Assistant," is the only work I know of upon the subject, but it has no reference to *water power;* it is a very useful little book, however, and every mechanic ought to be possessed of a copy.

A FRIEND TO SCIENCE.

Glasgow, 12th Nov. 1824.

SKETCH OF THE HISTORY OF PHILOSOPHY,

Particularly with reference to Mathematical and Mechanical Science.

(Continued from page 263, Vol. II.)

NOTWITHSTANDING the fine discoveries of Galileo, which ought to have rendered him an object of the veneration and gratitude of mankind, he was subjected to the most rigorous persecution, and twice was he brought before the *Holy* Inquisition. A council of seven cardinals pronounced a sentence which condemns its authors to eternal infamy, and which, for the sake of those who believe that power can subdue truth, should never be forgotten.

The following is a complete and correct translation of this extraordinary sentence, and as it appeared but once in English a good many years ago, we think it cannot fail to be interesting to our readers. It will be of importance, too, in another point of view; when we consider the exertions that are now making to obtain Catholic Emancipation in the ensuing session of Parliament; this sentence of a church that pretends to be *infallible,* that holds every thing that *she hath done, can do, and will do, must be right, and that no faith is to be kept with heretics,* will serve perhaps better than the most learned discussion, to prove how dangerous and absolutely foolish it would be to give her one iota of more privileges in this country than she already possesses.

WE, Gaspar, of the title of Holy Cross of Jerusalem. Borgia, brother Felix Certinus, of the title of St. Anastatia, surnamed of Asculum. Guidus, of the title of St. Mary, of the people. Bentivolus, Brother Desiderius Scaglia, of the title of St. Charles, surnamed of Cremona. Brother Antonius Barbarinus, surnamed of St. Onuphrius. Landivius Zacchia, of the title of St. Peter in Vinculis, surnamed of St. Sixtus. Berlingerius, of the title of St. Augustin Gyposius. Fabricius, of St. Lawrence. Francis, of St. Lawrence. Martin, of the new St. Mary and Ginethis. Deacons, by the mercy of God, Cardinals of the Holy Roman Catholic Church, and specially deputed by the Holy Apostolical See, as Inquisitors-General against Heretical Perverseness throughout the whole Christian commonwealth.

Whereas, you, Galileo, son of the late Vincent Galileo, of Florence, being 70 years of age, had a charge brought against you, in the year 1615, in this Holy Office, that you held as true, an erroneous opinion, held by many, namely, That the sun is in the centre of the world, and immoveable, and that the earth moves even with a diurnal motion; also, that you had certain Scholars, into whom you instilled the same doctrine; also, that you maintained a correspondence on this point with certain mathematicians of Germany; also, that you published certain Epistles, treating of the Solar spots, in which you explained the same doctrine as true, because you answered to the objections, which, from time to time, were brought against you, taken from the Holy Scripture, by glossing over the said Scripture according to your own sense, and that, afterwards, when a copy of a writing, in the form of an Epistle, written by you to a certain late Scholar of yours, was presented to you, (it following the hypothesis of Copernicus,) you stood up for, and defended, certain

propositions in it, which are against the true sense and authority of the Holy Scripture.

This Holy Tribunal, desiring, therefore, to provide against the inconveniences and mischiefs which have issued hence, and increased, to the danger of our Holy Faith; agreeably to the mandate of Lord N——, and the very eminent Doctors, Cardinals, of this supreme and universal Inquisition, two propositions respecting the immobility of the sun, and the motion of the earth, were adopted and pronounced as under:—That the sun is in the centre of the world, and immoveable in respect of local motion, is an absurd proposition, false in philosophy, and formally heretical, seeing it is expressly contrary to Holy Scripture. That the earth is not the centre of the world, nor immoveable, but moves even with a diurnal motion, is also an absurd proposition, false in philosophy, and, considered theologically, is at least an error in faith.

But, whereas, we thought fit, in the interim, to proceed gently with you, it was agreed upon in the Holy Congregation, held before D. N. on the 25th day of February, 1616, that the most eminent Lord Cardinal Bellarmine, should enjoin you entirely to recede from the aforesaid false doctrine; and, on your refusal, it was commanded by the Commissary of the Holy Office, that you should recant the said false doctrine, and should not teach it to others, nor defend it, nor dispute concerning it; to which command, if you would not submit, that you should be cast into prison; and, in order to put in execution the same decree, on the following day, you were gently admonished in the palace before the above said most eminent Lord Cardinal Bellarmine, and afterwards by the same Lord Cardinal, and by the Commissary of the Holy Office, a notary and witnesses being present, entirely to desist from the said erroneous opinion; and that, thereafter, it should not be permitted you to defend it, or teach it, in any manner, either by speaking or writing; and, whereas, you promised obedience, you were at that time dismissed.

And to the end, such a pernicious doctrine might be entirely extirpated away, and spread no farther, to the grievous detriment of the Catholic verity, a decree was issued by the Holy Congregation *Indicis*, prohibiting the printing of books which treat of such sort of doctrine, which was therein pronounced false, and altogether contrary to Holy and Divine Scripture.

But the same book has since appeared at Florence, published in the year last past, the inscription of which showed that you were its author, as the title was "A Dialogue of Galileo Galilei," concerning the two principal systems of the world, the Ptolemaic and the Copernican, as the Holy Congregation recognising from this impression of the aforesaid book, that the false opinion concerning the motion of the earth, and the immobility of the sun, prevailed daily more and more; the aforesaid book was diligently examined, when we openly discovered the transgression of the aforesaid command, before enjoined you; seeing that in the same book you had resumed and defended the aforesaid opinion already condemned, and in your presence declared to be erroneous; because, in the said book, by various circumlocutions, you earnestly endeavoured to persuade, that it is left by you undecided, and, at the least, probable, which must necessarily be a grievous error, since an opinion can, by no means, be probable, which hath already been declared and adjudged contrary to Divine Scripture.

Wherefore, you have, by our authority, been summoned to this our Holy Office, in which being examined, you have, on oath, acknowledged the said book was written and printed by you. And have also confessed, that about ten or twelve years ago, after the injunction had been given you as above, the said book was begun to be written by you. Also, that you petitioned for licence to publish it, but without signifying to those who gave you such licence, that it had been prohibited you not by any means to maintain, defend, or teach such doctrine. You likewise confessed, that the writing of the aforesaid book was so composed in many places, that the reader might think that arguments adduced on the false part, calculated rather to perplex the understanding by their weight, than be easily resolved; excusing yourself, by saying, you had fallen into an error so foreign from your intention, (as you declared,) because you had handled the subject in the form of a Dialogue, and because of the natural complaisance which every one hath in maintaining his own arguments, and in showing himself more acute than others, in defending even false propositions, by ingenious deductions, and of apparent probability. And, when

a time was assigned you for making your defence, you produced a certificate, under the hand-writing of the most eminent Lord Cardinal Bellarmine, procured, as you said, in order to defend yourself against the calumnies of your enemies, who everywhere gave it out that you had abjured, and had been punished by the Holy Office; in which certificate it is said, that you had not abjured, nor had been punished, but only that a declaration had been filed against you, drawn up by the said Lord, and formally issued by the Holy Congregation *Indicis*, in which it is declared, that the doctrine concerning the motion of the earth, and the immobility of the sun, is contrary to the Holy Scriptures, and therefore can neither be defended nor maintained.

Wherefore, seeing no mention was then made of two particulars of the mandate, namely, *(docere et quovis modo,)* "teaching, and by any means," we judge, that in the course of fourteen or sixteen years, they had slipt out of your memory, and for the same reason you were silent respecting the mandate, when you petitioned for a licence to print your book; and yet this was said by you not to maintain, or obstinately persist in your error, but as proceeding from vain ambition, and not perverseness. But this very certificate, produced in your defence, rather tends to make your excuse look worse, because in it is declared, that the aforesaid opinion is contrary to the Holy Scripture, and yet you have dared to treat of it as a matter of dispute, and defend and teach it as probable; nor does the licence itself favour you; seeing it was deceitfully and artfully obtained by you, as you did not produce the mandate imposed upon you.

And, whereas, it appeared to us, that the whole truth was not expressed by you respecting your intention, we have judged it necessary to come to a more accurate examination of the business, in which (without prejudice to those things which you have confessed, and which have been brought against you as above, respecting your said intention) you have answered as a penitent, and good Catholic. Wherefore, we, having maturely considered the merits of your cause, together with your above-said confessions and defence, are come to the underwritten definitive sentence against you.

Having invoked the most holy name of our Lord Jesus Christ, and of his most glorious Mother, the ever-blessed Virgin Mary, we, by this our definitive sentence, by the advice and judgment of the most reverend Masters of the Holy Theology, and the Doctors of both Laws, our Counsellors, respecting the cause and causes controverted before us, between the magnificent Charles Sincerus, Doctor of both Laws, Fiscal Procurator of this Holy Office, on the one part, and you Galileo Galilei, defendant, questioned, examined, and having confessed, as above, on the other part, we say, judge, and declare, by the present processional writing, you, the above-said Galileo, on account of those things which have been adduced in the written process, and which you have confessed, as above, that you have rendered yourself liable to the suspicion of Heresy by this Office, that is, you have believed and maintained a false doctrine, and contrary to the Holy and Divine Scriptures, namely, that the sun is the centre of the orb of the earth, and that it does not move from the east to the west, and that the earth moves, and is not the centre of the world; and that this position may be held and defended as a probable opinion, after it had been declared and defined to be contrary to the Holy Scripture; and, consequently, that you have incurred all the censures and penalties of the Holy Canons, and other constitutions, general and particular, enacted and promulgated against such delinquents, from which it is our pleasure to absolve you, on condition, that, first, with sincere heart and faith unfeigned, you abjure, execrate, and detest, the above errors and heresies, and every other error and heresy contrary to the Catholic and Apostolical Roman Church, in our presence, in that formula which is hereby exhibited to you.

But that your grievous and pernicious error and transgression may not remain altogether unpunished, and that you may hereafter be more cautious, serving as an example to others, that they may abstain from the like offences, we decree, that the book of the Dialogue of Galileo, be prohibited by public edict, and we condemn yourself to the prison of this holy office, to a time to be limited by our discretion; and we enjoin, under the title of salutary penance, that, during three years to come, you recite, once a-week, the seven penitential psalms, reserving to ourselves the power of mo-

derating, changing, or taking away entirely, or in part, the aforesaid penalties and penitence.

And so we say, pronounce, and by our sentence, declare, enact, condemn, and reserve, by this and every other better mode or formula, by which of right, we can and ought.

So we, the underwritten Cardinals, pronounce, F. Cardinal de Asculo, G. Cardinal Bentivolus, F. Cardinal de Cremona, Fr. Antony Cardinal S. Onuphrii, B. Cardinal Gyposius, F. Cardinal Verospius, M. Cardinal Ginettus.

The Abjuration of Galileo.

I, Galileo Galilei, son of the late Vincent Galileo, a Florentine, of the age of seventy, appearing personally in judgment, and being on my knees, in the presence of you, most eminent and most reverend Lords, Cardinals of the Universal Christian Commonwealth, Inquisitors General against Heretical Depravity, having before my eyes the Holy Gospels, on which I now lay my hands, swear that I have always believed, and now believe, and, God helping, that I shall for the future, always believe whatever the Holy Catholic and Apostolic Roman Church holds, preaches, and teaches. But because this Holy Office had enjoined me by precept, entirely to relinquish the false dogma, which maintains, that the sun is the centre of the world, and immoveable, and that the earth is not the centre, and moves; nor to hold, defend, or teach, by any means, or by writing, the aforesaid false doctrine; and, after it had been notified to me, that the aforesaid doctrine is repugnant to the Holy Scripture, I have written and printed a book, in which I treat of the same doctrine already condemned, and adduce reasons with great efficacy in favour of it, not offering any solution of them; therefore I have been adjudged and vehemently suspected of Heresy, namely, that I maintained and believed, that the sun is the centre of the world, and immoveable, and that the earth is not the centre, and moves.

Therefore, being willing to take out of the minds of your Eminences, and of every Catholic Christian, this vehement suspicion, of right, conceived against me, I, with sincere heart, and faith unfeigned, abjure, execrate, and detest the abovesaid errors and heresies, and generally every other error and sect, contrary to the abovesaid Holy Church, and I swear, that I will never any more hereafter say or assert, by speech or writing, any thing through which the like suspicion may be had of me: but, if I shall know any one Heretical, or suspected of Heresy, I will denounce him to this Holy Office, or to the Inquisitor and Ordinary of the place, in which I shall be. I moreover swear and promise, that I will fulfil and observe entirely, all the penitences which have been imposed upon me, or which shall be imposed by this Holy Office. But if it shall happen that I shall go contrary (which God avert) to any of my words, promises, protestations, and oaths, I subject myself to all the penalties and punishments, which, by the holy Canons, and other Constitutions, general and particular, have been enacted and promulgated against such delinquents: So help me God, and his Holy Gospels, on which I now lay my hands.

I, the aforesaid Galileo Galilei, have abjured, sworn, promised, and have bound myself as above, and in the fidelity of those, and with my own hands, and have subscribed to this present writing of my abjuration, which I have recited word by word. At Rome, in the Convent of Minerva, this 22d of June, of the year 1633, I, Galileo Galilei, have abjured as above, with my own hand.

Galileo Galilei.

DESCRIPTION OF A PROPORTIONAL SCALE FOR REDUCING PLANS, MAPS, &c.

This instrument consists of two flat brass limbs, of unequal lengths, turning upon a centre pin, which is fixed upon a brass box, filled with lead, having three points at the bottom, to keep it firmly fixed to the table: a nut screws on at the top of the centre pin, to keep the brass limbs steady.

The longer limb is in length, from the centre, twenty eight inches one quarter, and is graduated

into inches and tenths of inches; the shorter limb, which is nineteen inches and a half long, has on it four or more scales of inches, divided into smaller parts; as fifteenths, twentieths, twenty-fifths, thirtieths, &c. An index moves on this limb, having a spring with a projecting point underneath connected with it.

To make use of the instrument, turn the plan you wish to reduce bottom upwards, as the instrument inverts it in the reducing, and, bringing the graduated edge of the longer limb to any angular or remarkable point of the plan, &c.: observe what division it coincides with, and set the index on the shorter limb to the corresponding division on that scale you wish to reduce it to; then, putting your fair paper underneath, make a point upon it by pressing the spring with your thumb; then again move the longer limb, till some other angular point, or other remarkable part, coincides with its graduated edge; and, observing the division again, move the index to the same division on the scale, and make a point as before.

In this manner proceed till all the angular or remarkable points are thus transferred to the fair copy, which may afterwards be joined by right or other lines.

It is obvious that every angular point must be taken; and the greater number of other remarkable points that are transferred, the more correct your plan will be.—*Trans. of the Society of Arts.*

METHOD OF CURING AND DRYING HERRINGS IN THE ISLE OF MAN.

The unloading of the boats, and carrying the fish to the respective herring-houses, where they are thrown down under large sheds built for that purpose, are done by women. There are two men ready to shovel them up in *layers*, as they come in, and throw a proper quantity of salt over every layer. In that situation they remain for several days, till it is judged they have imbibed a sufficient quantity of it for curing, and also preserving them for exportation. The next operation is washing them, which is done in large open baskets, placed within very large tubs of water, where the buckets are briskly worked about, till the fish are thoroughly cleansed from the loose salt and slime that are adhering to them.

The washing is very hard work; requiring much strength; it is therefore allotted to the men to perform. The women, however, take the baskets from the men, and carry them into the drying-houses, where they throw them down in heaps, there to drain a while. The next procedure is called spitting the fish. A vast quantity of *split* hazle-sticks, well dried and hardened by fire, is ready prepared for the pupose. The herrings are fastened, or strung, (if I may employ the expression,) upon these sticks, by running them through their gills.—The next operation is putting them up in those large drying-houses, which are fitted up with proper framings, like so many *stout upright* ladders, from the bottom to the top of the building; those framings being fixed at such a distance from each other that a man may easily ascend betwixt them, in order to convey those spits to the highest ranges, which they fill the first, and so keep descending, till the whole of that partition is filled to near the bottom. The sticks are handed up when past easy reach from the bottom, from one person to another, standing across the

opening, with one foot on each side; and in the same method they proceed till the whole house is filled.

Wood fires are then lighted up, to dry, harden, and smoke them sufficiently. When that is done, they are taken down in the same manner they were placed up; then taken from the sticks, and put down *very close*, into large casks, which finishes the business of curing.

Every operation is gone through in a very quick and ready manner, and with wonderful adroitness by all employed.

The drying-houses are very lofty buildings, from twenty to thirty yards long and upwards, with proportionable width. The cleansings of the washing-tubs are esteemed a first-rate manure for land, so are the sweepings of every outhouse or room where any part of the business is carried on. It is too valuable an article to be obtained from the herring merchants, who use it for their own grounds, which are thereby covered with an uncommonly rich and lasting verdure.

T.

ON SOLIDITY AS A PROPERTY OF MATTER.

All our ideas of Solidity are received through the medium of the sense of touch. It is that property of matter by which it fills space; or, by which any portion of matter excludes every other from that part of space which it occupies, and thus it is capable of resistance or protusion. This resistance is so effectual, that the greatest force which can possibly be applied, is not capable of dislodging it, so as to occupy the same part of space which *it* already possesses. This is evident from the fact, that a piece of wood, placed between two plates of metal, can never be compressed in such a manner as to allow the plates to come into contact. In the same way, a drop of water, if confined on all sides in such a manner as to prevent it from giving way to the applied pressure by escaping, will effectually resist every attempt to bring the sides of the globe containing it together, without forcing the water through the pores of the metal.

The softest bodies then are equally solid with the hardest; for it would be absurd to suppose that any two bodies could occupy the same space at one time; since we know, that if a small quantity of water, or air, be fixed between two bodies, they can, by no force, be so compressed, as to permit the bodies to meet one another. When we use the term *Solid*, as designating hard bodies, in opposition to fluids; we mean those whose parts adhere to each other with more or less force; being thus distinguished from fluids, whose parts yield by going out of the way upon the least external pressure. The term Solidity, however, has been used by Mathematicians, in a different acceptation from the one just stated. Solidity, in Geometry, denotes the quantity of space contained, or occupied by a solid body, and is estimated by the number of solid, or cubic inches, feet, and yards, which it contains. In this sense of the word, then, a Solid is a body of the third species of magnitude, or that which has three dimensions; consisting of length, breadth, and thickness, in contradistinction to a *surface* which has only two dimensions, and to a *line* which has only one; and, in this view, the Solidity of a body denotes the quantity, or space contained in it, and is called the *Solid Content*.

Regular Geometrical Solids are such as are terminated by regular and equal planes; such as the Tetrahedron, the Cube or Hexahedron, the Octohedron, the Dodecahedron, and the Icosahedron. All such as do not come under this definition, are irregular Solids; such as, the Sphere, Cylinder, Cone, &c.

This property of matter, however, may be considered abstractly as a property of the real gravity of matter which exists in bodies, rather than as a general one, applying to all bodies in their usual state of existence. "There is no idea," indeed, says Locke, "which we receive more constantly from sensation than Solidity. Whether we move or rest, in what posture so ever we are, we always feel something under us that supports us, and hinders our farther sinking downwards; and the bodies which we daily handle, make us perceive that, whilst they remain between them, they do by an insurmountable force hinder the approach of the parts of our hands that press them."

D.

MISCELLANIES.

ERPETUAL MOTION.

orrespondent, J. M. Coldstream, sure that he has discovered this ught desideratum, if the following be answered in the affirmative:— a vacated vessel (i. e. emptied of defended from the pressure of the here, by being surrounded by a f compressed air."

LIME.

Correspondent, L. M'L. suggests, hen limestone cannot be had, very ime may be made, by burning limpet, &c., shells, collecting when burnt, into a heap, sprinkis with warm water, and covering thin clods of earth for three or ours; on removing the earth, the shells will have become a mass of s fine as flour, as white as snow, xcelling in strength and tenacity lime and stucco.

T. VINCENT STREET.

Inhabitant accounts for the blunthe porter with the hare, by ing us that a *part* of the *Street* is "Blythswood Place;" he comof this as a great absurdity, and t not only causes great confusion, revents himself and his neighbours numbering their houses, as they t know what numbers to put on.

QUERY.

hat is the best mode of filtering e water, such as the Molendinar or mlachie Burns, for the purposes of ing and dyeing, or of supplying a engine, without hurt to the pumps, r where clay or such pernicious nce intervenes?

CLAVIUS.

ristopher Clavius, whose talents in etry made him regarded as a second Euclid, was, when young, entered in a College of Jesuits at Bamberg.—After he had been tried in various branches of learning, he was on the point of being dismissed as a hopeless blockhead, till one of the fathers thought he would make a trial of him in geometry, which hit his genius so luckily, that he afterwards became one of the greatest mathematicians of the age.

TO REMOVE GREASE SPOTS FROM PAPER.

Scrape finely some pipe clay; the quantity will be easily determined on making the experiment; on this lay the sheet or leaf, and cover the spot in like manner with the clay. Cover the whole with a sheet of paper, and apply, for a few seconds, a heated ironing box, or any substitute adopted by laundresses. On using India rubber, to remove the dust taken up by the grease, the paper will be found restored to its original whiteness and opacity.—*Oracle of the Arts.*

TO MAKE BLACK AND COLOURED SEALING WAX.

Black sealing-wax is made by stirring into any quantity of melted gum-lac, or shell-lac, half its weight or less, of finely levigated ivory black; adding, to improve the beauty of the wax, as well as to prevent its becoming too brittle, half their united weight of Venice turpentine. When the whole is properly melted, and incorporated by sufficient stirring over a slow fire, it is poured on a stone or iron plate, which has been previously well oiled; and, while soft, rolled into sticks. The sticks, both of red and black wax, are lastly exposed to a proper degree of heat for acquiring an agreeably glossy surface. In a similar way, substituting verditer, Prussian blue, and other proper powders, for ivory black, may easily be made sealing-wax of any desired colour. —*Ib.*

SPECIMEN OF THE ALGEBRAIC EXERCISES

rmed by the Students of the Mathematical Class, Anderson's Institution.

EQUATIONS,

Resolved by Addition.

A person bought a chaise, horse, harness, for £60; the price of the horse was twice the price of the harness, and the price of the chaise was twice the price of both; what was the price of each?

Let $x =$ the price of the harness;
Then $2x =$ ″ ″ ″ ″ horse;
And $6x =$ ″ ″ ″ ″ chaise.

Hence, $9x = 60$ per question.
Therefore, $x =$ £6 ″ 13 ″ 4.
Wherefore, £ 6 ″ 13 ″ 4 price of harness;
Also, £13 ″ 6 ″ 8 ″ ″ horse;
And, £40 ″ 0 ″ 0 ″ ″ chaise.

2. Divide the number 36 into three such parts that $\frac{1}{2}$ of the first, $\frac{1}{3}$ of the second, and $\frac{1}{4}$ of the third, shall be all equal to each other.

Let x denote the equal quotient.
Then $2x =$ the first part,
$3x =$ the second ″
$4x =$ the third ″

Hence $9x = 36$ per question,
Whence $x = 4$; Therefore,
$2 \times 4 = 8$ the first part,
$3 \times 4 = 12$ the second ″
$4 \times 4 = 16$ the third ″

3. A, B, and C, bought a hive for 20/; A agrees to pay $\frac{1}{2}$, B $\frac{1}{3}$, and C $\frac{1}{4}$; what is the *proportional* share of each?

Let $12x$ denote the sum; which, being divided by the fractions, will give the *proportional* shares.
Then $6x =$ A's share.
$4x =$ B's do.
$3x =$ C's do.

Whence $13x = 20$ per question.
Therefore $x =$ 1/6 $\frac{6}{13}$
Hence $12x =$ 18/5 $\frac{7}{13}$ the required sum.
Whence $\frac{1}{2} =$ 9/2 $\frac{10}{13}$ A's share.
$\frac{1}{3} =$ 6/1 $\frac{11}{13}$ B's do.
$\frac{1}{4} =$ 4/7 $\frac{5}{13}$ C's do.

Equations,

Resolved by Subtraction.

1. A post is $\frac{1}{4}$ of its length in mud, $\frac{1}{3}$ in water, and 10 feet above water; what is its whole length?

Let $12x =$ whole length.
$\frac{1}{4} = 3x =$ part in mud.

$9x$
$\frac{1}{3} = 4x =$ part in water.

Whence $5x = 10 =$ part above water.

Therefore $x = 2$, and $12x = 24 =$ the whole length.

2. A captain being asked how many soldiers he had in his company, replied, $\frac{1}{2}$ of them are in the camp, $\frac{1}{3}$ in the trenches, $\frac{1}{4}$ in the hospital, and 4 in prison; how many soldiers had he?

Let $24x =$ the company.
$\frac{1}{2} = 12x =$ part in the camp.

$12x$
$\frac{1}{3} = 8x =$ part in the trenches.

$4x$
$\frac{1}{8} = 3x =$ part in the hospital.

Whence $x = 4$ in prison.
Therefore $24x = 96$ the company.

Equations,

Requiring the assistance of both Rules.

1. A person at a tavern borrowed as much money as he had about him, and then spent a shilling; he went to a second tavern, borrowed as much as he had remaining, and spent another shilling; in this manner, he went to a third and a fourth tavern, and, after spending a shilling at the last, he had nothing left; what had he at first?

Let $x =$ money he had at first.
$x =$ ″ borrowed at 1st tavern.

$2x$
$1 =$ ″ spent ″ ″ ″

$2x - 1 =$ ″ left ″ ″ ″
$2x - 1 =$ ″ borrowed at 2d tavern.

$4x - 2$
$1 =$ ″ spent ″ ″ ″

$4x - 3 =$ ″ left ″ ″ ″
$4x - 3 =$ ″ borrowed at 3d tavern.

$8x - 6$
$1 =$ ″ spent ″ ″ ″

$8x - 7 =$ ″ left ″ ″ ″
$8x - 7 =$ ″ borrowed at 4th tavern.

$16x - 14$
$1 =$ ″ spent ″ ″ ″

$16x - 15 =$ ″ left ″ ″ ″

But $16x - 15 = 0$ per question;
Whence $16x = 15$ by transposition;
And $x = \frac{15}{16}$/ ″ $= 11\frac{1}{4}$d. Answer.

2. In a mixture of copper, tin and lead, $\frac{1}{2}$ of the whole *minus* 16 lb. was copper; $\frac{1}{3}$ of the whole *minus* 12 lb. was tin; and $\frac{1}{4}$ of the whole *plus* 4 lb. was

lead; how much of each metal was in the mixture?

Let $12x =$ lbs. in the whole mixture.

Then $6x - 16 =$ lbs. of copper.

$4x - 12 =$ lbs. of tin.

$3x + 4 =$ lbs. of lead.

$13x - 24$

Whence $13x-24 = 12x$ per question.

And $13x-12x = 24$ by transpos.;

Therefore $x = 24$; and

hence $12x=288$ lbs. in the mixt.

Hence $144-16 = 128$ lbs. of copper,

$96-12 = 84$ lbs. of tin,

$72+4 = 76$ lbs. of lead.

(To be continued.)

MR. CAMPBELL'S PROOF OF CLAIMS

FOR THE

INVENTION OF THE DISCHARGING PRESSES.

To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

SIR,—In No. XXIX, Vol. I., of your Magazine, 17th July, I find Mr. John Miller's answer to mine of the 13th March. In consequence of business requiring my absence from home for a few weeks, and his paper not being put into my hands for some time after I had returned, I had not so early an opportunity of answering it, as I could have wished. In this reply he very *modestly* claims the invention of discharging Turkey Red, by means of presses, and says, " Now what is it that Mr. Rodger and Mr. Campbell did accomplish?" I answer, that as early as the year 1801, I did make plates which accomplished all the purposes intended for the discharging of Turkey Red Bandannas, and these plates are in use to this day; and it does not appear that any other substitute could supersede them. In proof of this assertion, I beg leave to lay before the public the following evidences:—

Barrowfield, 24th September, 1808.

MR. CAMPBELL,

SIR,—I have been applying to Mr. Bogle for my last Indenture, which is now fulfilled. He informs me that it is at Blantyre. I would take it kind if you would send it to the warehouse next week, as it will save me the trouble of coming to Blantyre.

I am, SIR, your humble Servant,
COLIN M'CALLUM.

The above shows that Colin M'Callum's Indenture, which was for seven years, (to work the Presses, and to make the discharging liquor, to wash the cloth, and fold the goods after being finished,) expired in 1808, which makes the date of his Indenture 1801.

Blantyre Works, 9th April, 1824.

This is to certify that about the year *1801, I was ordered to* cast a number of lead plates for discharging red cloth, by Mr David Campbell, then Manager at Blantyre Works; attested by me,

HUGH WEIR.

Blantyre Works, 10th April, 1824.

This is to certify that about the year 1801, I cut and finished several discharging Press screws, by the direction of Mr. David Campbell, then Manager of Blantyre Works; attested by me,

ALEXANDER WATERSON.

Pollokshaws, 13th August, 1824.

MR. CAMPBELL,

DEAR SIR,—Understanding you to be engaged in a controversy, I send you these few lines, informing you, that, according to my judgment and recollection, I went to Blantyre Works in the year 1801, and by your orders and directions, commenced finishing plates composed of tin and lead, by planing and boring, likewise the canals on the top of the wooden plates, were put on agreeable to the design of the pattern, so that the liquor might have free access to run. The whole of these plates were divided and drawn by the different patterns, solely by yourself, as were the two first plates, before I commenced my Indenture for 7 years, for discharging Turkey Red Bandannas. I believe that Colin M'Callum and John Strathearn, were engaged for the same number of years, to work the Presses, and also to keep the whole process of making and discharging a profound secret, for no person or persons were admitted into the house, but by your authority, as you were at that time manager of Blantyre Works, (or by one or other of the proprietors); so strict orders were we under to keep the whole process a profound secret; and we thought it reasonable, because we believe, that there was no process of the same nature in Britain; and we frequently insisted on you to speak to Mr. Monteith to take out a patent, in order that he might secure and reap the benefit. After

a number of years, Mr. Monteith caused to be removed the presses and utensils down to Barrowfield.

I am, DEAR SIR, your's, sincerely,
GEORGE STRATHEARN.

Extract from a letter of Mr. Miller's, Ballantrae:

Post Office, Ballantrae, 12th April, 1824.

DEAR SIR,—After a careful perusal of the statement of your claims for the invention of the process of discharging Turkey Red Bandannas, in the Glasgow Mechanics' Magazine, for the 13th of March last, I do, without hesitation, pronounce your claims to rest on sure and solid grounds, and so can many others, yet alive, who were then at the Works. I went to Blantyre Works, as a teacher, in the month of July, 1797, and I left the works, 24th October, 1804. You were appointed sole manager of both Mills, and before Mr. James Monteith's death, which happened on the 16th July, 1801, you had completely succeeded in experiments on the discharging of Turkey Red, with brass plates of 16 holes. I well recollect the great secret of the spotting business, as it was then called. I recollect that Alexander Waterson cut the first screws for the large presses, and that Hugh Weir, Tinsmith, helped in casting the tin and lead plates. My old friend, Mr. George Strathearn, joiner, wrought constantly with you in the spotting house, (being agreed for that purpose), along with M'Callum, with whom I was not much acquainted.

I am, SIR, your's, &c.
JOHN MILLER.

The above attestations, I hope, are sufficient to convince every unprejudiced mind, that so early as the year 1801, Messrs. Monteith & Co., had completely succeeded in the process of discharging Turkey Red Bandannas, which, as is well known to the commercial world, has turned out a lucrative business. Now, allow me to ask, "*What is it that Mr. Miller did accomplish?*" He claims the merit of having invented a press for discharging, in the latter end of the year 1802, but he states that it was not seen until December, 1803. Presses were established at Blantyre Works two years before that. It may be very naturally supposed that he copied from *them*, but according to his own dates, it was impossible for *them* to have copied from him. His next invention, which is of the same date, are brass tubes or types. He says in No. XXIX., Vol. I., that 50 presses, with brass tubes, which had been made in Glasgow, were all working at once, a few years after his invention became known; all of these were in every respect made according to the first press constructed after his direction. Now, the question is, "What was the consequence of using his brass tubes?" It is well known that many individuals were ruined by them; others who were wealthy, abandoned them, as being destructive and unprofitable. Messrs. Monteith & Co., abandoned no part of their process, but these tubes alone. I now leave it to the public to judge, whether Mr. Miller, as an inventor, has any just claim of remuneration on Messrs. H. Monteith & Co.

DAVID CAMPBELL.

NOTICES TO CORRESPONDENTS.

"Biggin" is informed that the Table he alludes to, is quite common, and the results are generally ascribed to the author quoted.—J. C. R., under consideration.—"Mirus" has fallen into the *mire*.—M. A. wishes L. M'L. to describe the plant he calls *Neonan*; and if he can't, advises him to take it to a Botanist, who would give it both the Latin and English name; would not M. A.'s plan of filtering be liable to this objection, that the sand would soon sink below the gravel?—G. M. P. must be more explicit with his improvement on the air-pump.—We would thank G. S. for better solutions of the "Chronometer" and "Latitude" queries.—Rusticus's method of the weaver's beam was different, if we recollect right; we dare say B. T. won't dispute the originality of the rule for discount with him; we are more partial to the *general* demonstration of B. T. however, than the *particular rationale* of Rusticus; he is right in the Hill query.—A L...y under consideration.—E. E. has been received.—J. S. has been superseded.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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" A man of knowledge increaseth strength."—*Solomon.*

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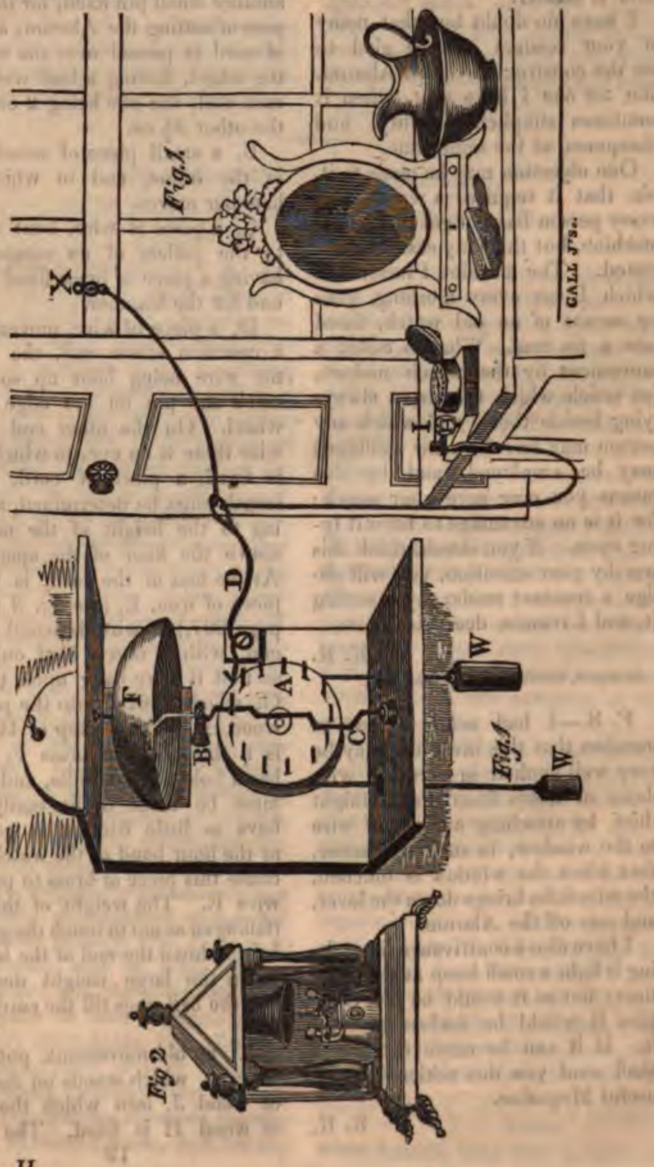
INGENIOUS AND SIMPLE ALARUM APPARATUS.



DESCRIPTION OF AN INGENIOUS ALARUM APPARATUS.

Mr. Editor,—I have often intended sending you the under-mentioned article, but from want of time, I have not been able to send it sooner.

I have no doubt but that many of your readers will be glad to see the construction of an Alarum, like the one I have sent, when it combines simplicity, utility, and cheapness, at the same time.

One objection may be made to it, *viz.* that it requires a watch, and every person has not got that useful machine, but this may easily be obviated. The machine I have, and which I use every morning, goes by means of an old watch, fitted into a tin case. What is called a movement by the watch makers, (an article which they have always lying beside them, and which any person may buy for a few shillings,) may be employed, and by this means you may save your watch; for it is no advantage to have it lying open. If you should think this worthy your attention, you will oblige a constant reader, by inserting it, and I remain, dear Sir, yours,

R. R.

Aberdeen, Broad-Street, Oct. 23d, 1824.

P. S.—I had nearly forgot to mention that this invention may be very well applied in securing windows or doors from the midnight thief, by attaching a piece of wire to the window, in such a manner, that when the window is touched, the wire falls, brings down the lever, and sets off the Alarum.

I have also a contrivance for making it light a small lamp at the same time; but as it would be too complex it would be useless to send it. If it can be made simpler, I shall send you due notice for your useful Magazine.

R. R.

Explanation of the Figures.

Fig. 1. A, a small wheel, with 13 wire pins on one side, having a groove cut round its edge, and into the edge another small pin fixed, for the purpose of setting the Alarum; a piece of cord is passed over the edge of the wheel, having a lead weight at each end, the one being 2 oz., and the other $3\frac{1}{2}$ oz.

B, a small piece of wood fixed in the frame, and in which the hammer moves.

C, a piece of wire, bent similar to the pallets of an escapement, having a piece of brass fixed at one end for the hammer.

D, a piece of wire, moveable on a common screw nail, the end of the wire being bent up so as to catch the pin on the edge of the wheel. On the other end of the wire there is an eye, to which there is fixed a piece of cord, whose length must be determined, according to the height of the machine above the floor of the apartment. At the end of the cord, is fixed a piece of iron, E, (see fig. 3 and 4, page 297,) or wire flattened at the end, with a notch filed out of it, so that it may hang upon the pin G, which is fixed into the piece of wood H. On the top of H, there is a thin piece of brass F, which has a hole in its middle, and which must be made to fit easily, and have as little friction as possible, as the hour hand of the watch must cause this piece of brass to push the wire E. The weight of this wire (falling so as not to touch the ground) brings down the end of the lever C, when the large weight descends, and the bell rings till the cord is run out.

K, an old movement, put into a tin case, which stands on the piece of wood J, into which the piece of wood H is fixed. The watch

should be level with it, to remove the friction as much as possible.

F, is I think the best form that can be given to the bell. The watch only requires one hand, namely, the hour hand.

X, is the notch or clasp on the window, to which a piece of wire may be attached, as in fig. 1., to prevent the depredations of the midnight thief, by setting off the Alarum.

The parts of the apparatus which are not marked in fig. 1., on account of their being so very small, will be seen quite distinctly in figures 3 and 4, page 297. Fig. 2 is a very neat form, which may be given to the apparatus, and which converts it into an elegant and amusing piece of furniture.

ON THE EXPANSION OF GASES,

With an Easy Rule, and a Table, for finding the Expansion of Air or any Gas, from 32° to 212° Fahrenheit.

An accurate knowledge of the expansion of gaseous bodies being of great importance in chemical researches, many experiments were made to ascertain it, but the results were long so various and different from each other, that none could be depended on. The reason of this difference was the want of attention on the part of experimenters, in not excluding with sufcient care the particles of water from the vessels employed to measure the expansion of gases. When, therefore, heat was applied to raise the temperature of any gas, the particles of water were converted into vapoür, and mixing with the gas, produced a difference in the actual change of bulk which it had experienced. To this cause, indeed, can only be ascribed the variations in the determinations of Deluc, General Roy, and others, on this important point. The subject happened to engage the attention of two very able philosophers about the same time, namely, Mr. Dalton, of Manchester, and M. Gay Lussac, in France; and the coincidence in the results of their experiments is not only remarkable, but affords a convincing proof of their accuracy. Mr. Dalton published the account of his experiments about six months before M. Gay Lussac, and his apparatus was much more simple than that of the French philosopher. It consisted merely of a glass tube, open at one end, and graduated into equal parts; after it was properly dried, the gas was introduced into it, and it was then filled with mercury at the open end to a given point; heat being then applied, the amount of dilatation was observed, by the quantity of mercury expelled. M. Gay Lussac's apparatus was rather more complicated, but capable of greater precision; and, as his experiments were made in greater quantities of air, their coincidence with the former induced perfect confidence in the accuracy of the results.

Their experiments led to the important conclusion, that air, and all gaseous bodies undergo the same degree of expansion, by the application of the same degree of heat; so that the rate of expansion for one being determined, gives the rate of expansion for all. The expansion obtained by M. Gay Lussac, by heating air from 32° to 212°, was .375, or $\frac{3}{8}$ of its bulk at 32°, and that obtained by Mr. Dalton, was .376 for the same bulk. Now, this fact being established, that air expands about $\frac{3}{8}$, or $\frac{1}{2.666}$ of its bulk, when heated, from 32° to 212°, or

180°; it follows, that for every 1° of the thermometer, air will expand $\frac{3}{8}$ of $\frac{1}{180}$, or $\frac{1}{480}$ part of its bulk at 32°. The experiments of Dalton would give about $\frac{1}{479.8+}$ for this expansion, but the difference is of no great moment. From the experiments of Gay Lussac, it appears, that the steam of water and the vapour of ether experience the same expansion as air, when the same addition is made to their temperature; hence, it may be inferred, that all elastic fluids expands equally and uniformly by heat.

To determine, therefore, the expansion of air, or any gas, at any temperature, or, in other words, to ascertain the increase of bulk which it undergoes, when heated from the commencement of the common thermic unit 32°, to any degree within its range, which terminates at 212°, we have only to add $\frac{1}{480}$ part of its bulk, at 32° for every degree between that point and the temperature required.

Thus, if the bulk of a quantity of any gas at 32°, be 10 cubic inches, and its bulk at 60° be required, we have only to subtract 32° from 60°, and the remainder 28 is the number of degrees intervening; then $\frac{1}{480} \times 28 = \frac{28}{480}$ the expansion of a unit for 28°; wherefore, $\frac{28}{480} \times 10$ cubic inches $= \frac{280}{480} = .5833$, the increase of volume, which, added to 10 cubic inches, makes 10.5833 cubic inches, the bulk of the gas at 32°, when raised to the temperature of 60°. If the bulk of a quantity of gas, at any temperature above 32° *be given, and* its bulk at a still higher temperature be required, we must first subtract 32° from the given temperature; then add the remainder to the denominator of the fraction $\frac{1}{480}$, and proceed as before. Thus, to find the expansion of 10 cubic inches of gas at 50°, when raised to the temperature of 60°, we have $50^{\circ} - 32^{\circ} = 18^{\circ}$, and $60^{\circ} - 50^{\circ} = 10^{\circ}$. Now, $\frac{1}{480+18} = \frac{1}{498}$, and $\frac{1}{498} \times 10^{\circ} = \frac{10}{498}$ the expansion of a unit for 10°; wherefore $\frac{10}{498} \times 10$ cubic inches $= \frac{100}{498} = .2008$, the increase of volume, which, added to 10 cubic inches, makes 10.2008 cubic inches, the bulk of the gas at 50°, when raised to the temperature of 60°.

If the bulk of a quantity of gas at a higher temperature be given, and its bulk at a lower temperature be required, we must then subtract 32° from each temperature, and add the remainders to the denominator of the fraction $\frac{1}{480}$; then making the least sum the numerator, and the greatest the denominator of a new fraction, we proceed with the operation as before. Thus, to find the contraction of 10 cubic inches of gas at 80° when cooled to the temperature of 60°, we have $60^{\circ} - 32^{\circ} = 28^{\circ}$; and $80^{\circ} - 30^{\circ} = 40^{\circ}$; also, $80^{\circ} - 60^{\circ} = 20^{\circ}$; hence, $\frac{480+28}{480+48} = \frac{508}{528}$, the expansion of a unit for 20°; wherefore, $\frac{508}{528} \times 10$ cubic inches $= \frac{5080}{528} = 9.4318$ cubic inches, the volume of the gas at 80°, when cooled down to the temperature of 60°.

Such is the mode of calculation adopted by chemists, in the calculation of the expansion of air and gas, and the examples might be so varied as to give occasion for a variation in the rules for each; but, we proceed to give a much more simple and general rule for determining this expansion in every case that can be proposed within the thermic unit, leaving its investigation till a future occasion, on account of the present length of this paper.

Rule. *The volumes of all the gases are to each other as* 448 + *the temperature;* that is, *as* 448 + *the given temperature, is to* 448 + *the required temperature, so is the bulk of a quantity of gas at the given temperature, to its bulk at the required temperature.* Thus, in the first of the above cases, we shall have 448 + 32° : 448 + 60° : : 10 cubic inches : 10.5833 cubic inches, or 480 : 508 : : 10 cubic inches : 10.5833 cubic inches, the bulk of the gas at 32°, when raised to the temperature of 60°, as found above.

In the second case, we shall have 448 + 50° : 448 + 60° : : 10 cubic inches : 10.2008 cubic inches, or 498 : 508 : : 10 cubic inches : 10.2008 cubic inches, the bulk of the gas at 50°, when raised to the temperature of 60°, as found above.

In the third case, we shall have 448 + 80° : 448 + 60° : : 10 cubic inches : 9.4318 cubic inches, or 528 : 508 : : 10 cubic inches : 9.4318 cubic inches, the bulk of the gas at 80°, when cooled down to the temperature of 60°.

From these examples will be seen the superiority of this single rule to the former methods of calculating the increase or diminution of the volumes of gases, when expanded by heat, or contracted by cold.

The following table, constructed on these principles, shows the expansion of air for nearly every temperature, from 32° to 212°, supposing that its bulk at 32° is unity 1.000000, or 1000000.

Temp.	Bulk.	Temp.	Bulk.	Temp.	Bulk.
32°	1000000	59°	1056249	86°	1112499
33	1002083	60	1058333	87	1114583
34	1004166	61	1060416	88	1116666
35	1006349	62	1062499	89	1118749
36	1008333	63	1064583	90	1120833
37	1010416	64	1066666	91	1122916
38	1012499	65	1068749	92	1124999
39	1014583	66	1070833	93	1127083
40	1016666	67	1072916	94	1129166
41	1618749	68	1074999	95	1131249
42	1020833	69	1077083	96	1133333
43	1022916	70	1079166	97	1135416
44	1024759	71	1081249	98	1137499
45	1027083	72	1083333	99	1139583
46	1029166	73	1085416	100	1141666
47	1031249	74	1087499	110	1162499
48	1033333	75	1089333	120	1183333
49	1035416	76	1091666	130	1204166
50	1037499	77	1093749	140	1224999
51	1039583	78	1095833	150	1245833
52	1041666	79	1097916	160	1266666
53	1043749	80	1099999	170	1287499
54	1045833	81	1102083	180	1308333
55	1047916	82	1104166	190	1329166
56	1049999	83	1106249	200	1349999
57	1052083	84	1108333	210	1378823
58	1054166	85	1110416	212	1375000

very different thing from the external sounds being reflected or reverberated from the interior of the shell, although the one is frequently mistaken for the other, even by our best writers on Acoustics; indeed, the reflection of sound is comparatively a phenomenon of rare occurrence. When one sound is excited by another, the second sound is generally the peculiar sound of some body, or portion of air confined, so as to be easily susceptible of the sounding state; and, consequently, easily excited by the vibrations transmitting the first sound.

If, then, the air within the shell is a sounding body, and is only excited by the pulsation of the air transmitting the sound, its sound may be so feeble that it cannot be heard at any great distance; and, certainly, its sound, as I formerly stated, will always remain the same, whatever is the nature of the external sound exciting it.

With regard to the effect noticed by G. M., observable on holding the hand close over the ear, it may or may not be produced, by the cause he assigned, without affecting the case of the shell. I am inclined, however, to think, that the muscles of the face and head are chiefly concerned in the production of that sound, for I find that the least motion of the jaws, or skin surrounding the ear, increases the sound in the shell.

I am, yours, &c.

A. B.

P.S. A Correspondent wishes to know the cause of the fact, that, in pouring a liquid into a vessel, the sound is at first grave, and becomes more acute as the vessel is filled.

There are two cases in which this takes place; first, in a bottle, or jar; or, second, in an open vessel; in both cases the cause is nearly similar. In the one, the air within the bottle, or jar, and in the other, the air in that portion of the vessel above the level of the liquid, becomes the sounding body; or, rather that part whose vibrations determine the vibrations of the whole mass of liquid and vessel, may be considered the sounding body, in the same manner as the string of a violin determines the vibrations of the whole instrument. As the vessel is filled, the air and that part of the vessel above the level of the liquid, become less, rendering the sound more acute, in the same manner as the shortening of the strings of the violin, or the lessening of the size of the pipes of an organ, renders the tones of these instruments more acute.

It is, remarkable, that the reverse takes place in tuning musical glasses. The addition of water makes the glass give a graver tone. In this case, however, the whole mass receives the sounding vibration, when the finger is passed over the edge of the glass. By increasing the mass, therefore, by the addition of water, we lengthen the sounding vibrations and obtain a graver sound.

A. B.

EASY MODE OF SPLITTING LARGE STONES.

Mr. Editor,—There is a method of splitting stone, which may be new to some of your readers. It will not do, probably, where there is a consolidated mass of rock, but to farmers, whose grounds are cumbered with large immoveable stones, it must prove highly useful. It is done simply by kindling a fire upon the upper surface. The heat expands the one side, while the other is kept cool, and splits it into pieces. The hardest whin stones, though eight or ten feet in breadth, may be broken in this manner, always taking care to increase and continue the

fire, according to the size of the stone. In large ones, it will take longer before the heat penetrates far enough to prove effectual; but, altogether, I have no doubt it will prove less laborious, less expensive, and infinitely less dangerous than the common mode of blasting.

W. B.

Glasgow, 23d November, 1824.

Fig. 3.

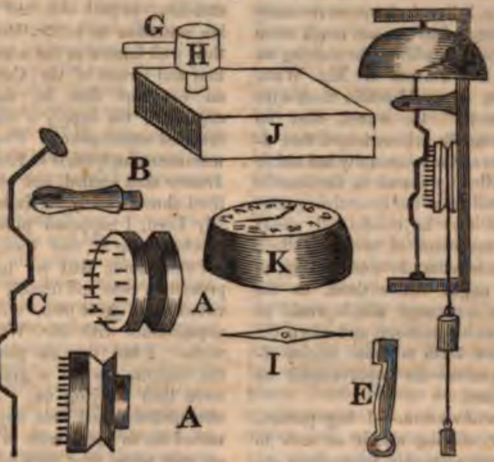


Fig. 4.

(*For description, see p.* 290.)

MONUMENT TO JAMES WATT.

On Wednesday last, at two o'clock, pursuant to advertisement, a numerous and highly respectable meeting was held in the Town Hall, to consider the best means of promoting a subscription for erecting a Monument to the memory of James Watt, in Glasgow, or in its vicinity.

On the motion of Henry Monteith of Carstairs, Esq. M.P.,

The Honourable the Lord Provost was *called to the Chair.*

The Lord Provost intimated that he had called the present meeting at the requisition of several of his fellow-citizens, to consider the best means of promoting a subscription for the purpose of erecting a monument to the memory of James Watt, in this city or its vicinity. He said, that in order to explain the reason why Glasgow should have been so late in coming forward to do honour to the memory of a man for whom, while living, there was reason to cherish so

high a regard, it would be proper for him to mention that many gentlemen entertained the idea of promoting the erection of one grand monument to his memory in Westminster Abbey, in preference to any thing of the kind here or elsewhere. This idea, however, on trial, had not succeeded, and would therefore fall to be superseded by (he trusted) the more successful efforts of this day. He believed there were many gentlemen present desirous, and much more able than himself, to address the meeting on the splendid endowments of Mr. Watt, and, therefore, he would detain them with but one remark. He stated, that he thought it generally acknowledged that almost all classes of the community had either directly or indirectly shared in the benefits that had flowed from the inventive genius of Watt, and that he trusted all would therefore be ambitious of testifying their sense of these benefits, by contributing, as their means might enable them, to the erection of a monument which would at once perpetuate his memory, and adorn the city which gave birth to those mighty efforts of his genius—his improvements on the steam engine.

Professor Jardine.—I beg pardon, my Lord, for offering myself so soon to your notice in this assenbly, where there are so many who have a preferable claim, and have it much more in their power to promote the object of this meeting; but it would not become me, who had so many opportunities of observing and admiring the genius and talents of that great man, to be the last in expressing my most hearty concurrence with every thing that can do honour to his memory. My Lord, I am one of the earliest and certainly one of the oldest friends of the late Mr. Watt. (Hear, hear.) I had the happiness of living with him in habits of intimacy and friendship the greatest part of my life. And I was particularly acquainted with him at the period when he was engaged in prosecuting those discoveries which have set him so far above all other men as an inventor in the Arts. I then enjoyed much of his confidence, and was present at many of his early experiments made with that view. But, lest it should be thought that I am putting in a claim for confidence and friendship with this great man to which I am not entitled, and which cannot now be contradicted, you will allow me to mention some of those circumstances which produced this intimacy. It may bring some things before this meeting which may not be displeasing in this assembly. When Mr. Watt had made such progress in his invention as to afford him a favourable prospect of the result, he found that other experiments must be made to satisfy the public, on a larger and much more expensive scale than he was able to make; a scale of expense to the amount of some thousand pounds—an expense that he was altogether unable to bear. He found it necessary, therefore, to part with half the benefits of his invention to a Dr. Roebuck, a name then well known in the country as the author and former of the Carron Company, on condition that he should bear the expense of the supply of the funds for the intended experiments. These experiments were accordingly made at Kinniel, where the Doctor then resided, and where Mr. Watt lived almost closely for six or eight months. My Lord, I happened to be Tutor to the Doctor's sons at that time, and no doubt did every thing that lay in my power to promote a close and friendly intercourse between these great men, which my former acquaintance with Mr. Watt enabled me to do. I had then the pleasure of seeing the experiments on a great scale which were then carrying on. This accidental circumstance, and this opportunity, connected me so much with what was going on, that when they were completed, I was asked by Mr. Watt to go with him to Berwick, when he went to give in a specification of his invention before a master of Chancery, previous to the obtaining of a patent; and many years afterwards, when a groundless and frivolous charge was brought against Mr. Watt by a person who claimed a share in the invention, I was called to give evidence of what I knew of this in Chancery. It is needless to add that Mr. Watt was triumphantly victorious. Mr. Watt was the certain and undoubted author of that invention, and no other person had any connection with it. I beg pardon for taking up so much time with these particulars, which have led me so often to mention myself. Mr. Watt's character as a man of genius is so well known as a man of the first rate genius, that it is unnecessary for me to say any thing on the subject. I can add nothing to what you know, and is so universally known. As one well said on a similar occasion, who would think of praising Sir Isaac Newton? Who has not heard of Mr. Watt's invention, and who has not benefited by it either in the way of pleasure or of profit! The person to whose memory we are now met to do honour, may be compared with men of the first rate genius in ancient or in mo-

nes. Sir Isaac Newton was the iscoverer of the Gravitation of Mr. Watt, as a great inventor Arts which changed the relative f many things on this Globe, and the wonderful things he has effect- opened up unbounded prospects of ty yet be expected. One claim Mr. is to fame which was denied even to c Newton. The Doctrine of Gra- was for a long time disputed by and other philosophers, and another preferred; but the invention of Mr. as immediately adopted. His claim alled fame has been universally ad- But Mr. Watt was not only y one great invention, he was also ished by many singular and uncom- lities. I have had occasion, during life, to observe the characters of their works and otherwise, but I et with any person who possessed may call a more inventive mind. mon and ordinary operation of his as Invention; almost every object acted his attention he conceived and ted as altered, changed, transformed, ied in a different state to other pur- d other uses, and his imagination r fruitful in expedients and re- When speaking of his great and on qualities, I cannot forget his and his simplicity of manners. g once upon his great invention, I m say, "that when it was analysed, not appear so great as it seemed to In the state," said he, "in which the Steam Engine, it was no great mind to observe, that the quantity ecessary to make it work, would prevent its extensive utility. The in my progress was equally easy, e what was the cause of the great tion of fuel; this too was readily l, viz. the waste of fuel which was to bring the whole cylinder, pis- adjacent parts, from the coldness to the heat of steam, no fewer than twenty times in a minute." This enormous expense of fuel. The was, how was this to be avoided ed? After considering it well, and those moments when the heavenly genius shone with brightness in his e idea of carrying on the condensa- separate vessel broke in upon him. step was more difficult, the form- e separate condensing vessel. The owledge he had of the mechanical nabled him to construct it, but I n heard him say this was a work of great difficulty, and that he met with many disappointments before he succeeded. I have often made use of this beautiful analysis received from Mr. Watt, in another department in which I have been long engaged, to illustrate and encourage the progress of genius in youth; to show, that once in possession of a habit of attention, under proper direction, it may be carried from one easy step to another, till the mind becomes qualified and invigorated for uniting and concentrating effort—the highest exertions of genius. I conclude with observing, that though men of genius may be said to be properly of every country, those of the same country consider themselves as having a particular interest in them. Upon this natural disposition, we who are here assembled have a particular interest in Mr. Watt. He belongs to this part of the country both by birth and education, and we feel, like others, some shade of conscious pride in this claim of ours. One object that may perhaps occupy this meeting is, whether there should be one separate monument in different places; or one great and magnificent one in the most appropriate place. I acknowledge my leaning is to one great, magnificent, and sublime monument, which shall command the attention of all, and which is likely to be lasting. I am for a monument which shall be durable, such as will wear out the teeth, as has been well said, of envious time, and hand down the memory of this great man to the latest posterity. (Applause.)

Mr. Monteith said. In rising to submit the motion he was about to make to the meeting, after the subject had been so well and ably introduced by the Lord Provost, and particularly, after the interesting history of the early years and rising genius of the great man on whose account this meeting had been called, it would not be necessary for him to occupy the time of the Gentlemen to any length. He was happy to think that although the measure of erecting a great national Monument in Westminster Abbey to the memory of that great man, James Watt, had not met with great encouragement in this city and district, that this arose entirely from a very general opinion that this city and neighbourhood, having derived the most essential benefits from Mr. Watt's discoveries, and the inhabitants being chiefly engaged in business immediately connected with these discoveries, therefore, it would be more appropriate to erect this Monument among themselves than at a distance. He would not enlarge on the transcendant talents of Mr. Watt, as this

own city contained two Gentlemen, one of whom had been, and the other is a Member of Parliament—the one a cotton spinner, and the other a weaver. (Laughter and cheers.) To the recent establishments for the instruction of mechanics in this city, he looked forward with equal pride and gratification. The system had originated in this city, and was now advancing over the kingdom. If, with the progress of intelligence, they united good order and subordination, he sincerely wished them all success and prosperity. At all events, it could not now be said, that, for lack of education,

> Full many a flower is born to blush unseen,
> And waste its sweetness on the desert air.

It was contemplating such an object—looking to a Monument for James Watt, not only as a memorial of the past, but an excitement to the future—not only as an expression of gratitude from the present generation, but as a stimulus to genius still unborn—that he anticipated the happiest effects, and that the passing spectator, when he cast his eye upon it, would exclaim, Glasgow expects every man to do his duty. (Loud cheering.)

Mr. William Smith then rose, and said he had the honour of submitting a motion to the meeting, which could require no argument of his to recommend it to their notice, not only because it appeared to follow almost as the necessary consequence of the Resolutions to which they had already agreed, but also because so much had already been said, and so well said, on the subject of the former Resolutions, equally applicable to that he now held in his hand, and in which he most cordially concurred. There were undoubtedly classes in the community, who, from having more directly benefited by the discoveries of Mr. Watt were more particularly called upon this day, than he was, and he was sure they would come nobly forward—but surely in such a city as this, much of its prosperity may be ascribed to the discoveries of that illustrious individual, and which has the honour of claiming him as a citizen: it was not too much to expect not only a liberal, but a general support to the measure now about to be adopted. He concluded by moving the following Resolution:

III. "That, for the reasons stated in the Second Resolution, all ranks and classes in this city and neighbourhood are particularly called upon to unite in erecting a suitable monument to his memory."

Dr. Thomson, in seconding the above Resolution, said. Every one was aware of the merits of Mr. Watt. He himself had the honour of his acquaintance for twenty-five years. Never before or since that period had he seen or heard of any person that was better acquainted with every topic, and had such a general knowledge and understanding. Many attempts had been made to improve Mr. Watt's engine, but the one made by himself was the best extant. All the new engines that are now erecting in Cornwall are upon his plan. The Learned Professor concluded, by saying, that the steam engine was not only the greatest but the completest present ever science made to the arts; and that the inventor had contributed more to the prosperity and aggrandizement of Great Britain than any man that ever existed.

Mr. Houldsworth said. No individual present more appreciated the memory of that illustrious gentleman, Mr. Watt, than he did. Some gentlemen present, who have so great powers of oratory, could speak from morning to night of his merits and his surpassing knowledge, and not exhaust the subject. Upon these grounds he would leave the case in abler hands. He concluded by moving the following Resolution, which was seconded by Professor Jardine:

IV. "That the gentlemen which he named, be appointed a Committee for the purpose of procuring subscriptions, with power to form themselves into Sub-Committees, and to add to their number when they think proper."

Dr. Ure, on being called on by the Lord Provost, spoke as follows:—Every citizen of Glasgow should feel grateful to the gentlemen at whose call this public meeting has been convened. The zeal and intelligence now displayed, will, I have no doubt, remove a cause of reproach from this city. London, Edinburgh, Greenock, besides several other towns of much less note than our own, have already paid their public tribute of admiration to the genius of Watt. But Glasgow alone, the scene of the greatest triumph ever achieved by mind over matter, because it was the place where that philosopher's mind was formed, and his inventive talents developed—Glasgow has remained silent, seeming to verify the wise saying, "A prophet is not without honour, save in his own country." The merits of Mr. Watt have been recently celebrated by statesmen, philosophers, and orators, of the first respectability in the kingdom; but so transcendant are these merits, that no praise hitherto bestowed can be called panegyric. In him were conjoined qualities deemed hardly compatible, and rarely associated in the same individual. The most lively fancy,

which could multiply at will mechanical combinations, or expatiate in the fields of romantic literature, was combined with the severest judgment, and an unwearied assiduity and unity of action in accomplishing his ends. The utmost ardour of friendship was blended with dispassionate considerations on the true interests of his friends. But the main scope of his mind, the great business of his life, was the investigation of the laws of nature, with the view of directing her powers to the uses of society. And in this respect justice has not been rendered to his fame, owing to an early and unintentional mistake of his friend Professor Robison, which remained uncorrected in public, from the modesty of Mr. Watt. Professor Robison, in his writings, represents Mr. Watt as deriving his knowledge of the constitution of steam, and consequently of the first principles of his steam engine, from the lessons of Dr. Black, whose lectures he is described as attending, at the period of making his steam-engine improvements.—May I be allowed to avail myself of this public opportunity to rectify that misapprehension? In the course of several conversations which I had the honour of enjoying with Mr. Watt, on the nature and force of steam at different temperatures, he informed me, with his characteristic mildness, that his friend, Professor Robison, had fallen into a mistake with regard to his being a pupil of Dr. Black at the time of his improving the steam engine; for that he never was a student of that philosopher. "As to the latent heat of steam," said Mr. Watt to me, "it was a piece of knowledge essential to my inquiries, and I worked it out myself in the best way that I could; I used apothecaries' phials for my apparatus, and by means of them I got approximations sufficient for my purpose at the time. With them, I ascertained the two main facts about steam; first, that a cubic inch of water would form about a cubic foot of ordinary steam; and, secondly, that the condensation of that quantity of steam would heat six cubic inches of water from the atmospheric temperature to the boiling point. Hence I saw that six times the difference of temperature, or fully 900 degrees of heat, had been employed in giving elasticity to the steam; which must be all abstracted before a complete vacuum could be produced under the piston of the steam engine."—It is not my intention to survey the philosophical researches of Mr. Watt. I may merely suggest to this meeting, many of whose members have been accustomed to regard him in the light only of a skilful engineer, that he has a joint claim with the Honourable Mr. Cavendish to the credit of one of the greatest discoveries in pure science, that of the compound nature of water; a body, till modern times, accounted an element. Mr. Watt drew this, which was the legitimate conclusion, from some experiments of Dr. Priestly and Mr. Warltire, while these gentlemen made another and erroneous inference. We are therefore come to express our admiration of a mind, great in original conception, admirable in execution, most beneficial in its results; a mind, to which every coming age will lift its eyes, as to one of the leading stars in British science. We are come to do reverence to a model of friendship, benevolence, and of every social virtue. We are assembled for the purpose of erecting a memorial to departed worth, which shall prove the strongest incentive to living industry and talent. And let us never forget, that Mr. Watt's genius had always useful objects in view. He lent himself to no party cabal, he displayed no love of power or popularity. Of this, the strongest proof is, his gliding into a private tomb, as James Watt. It might, indeed, have been expected, that a grateful country would have wreathed spontaneous honours round that living head, which had rendered it the most powerful among the nations, which had supplied it with the sinews of war, and had multiplied, in a degree scarcely calculable, the sources of its national wealth:

> "But nations, slowly wise and meanly just,
> To *buried* merit raise the tardy bust."

Let us rejoice, however, that this strange neglect of such surpassing excellence and usefulness no longer exists. From his Most Gracious Majesty to the working Mechanic, every man is ready to recognize the merits of James Watt, and to contribute in his sphere towards their celebration.

Thanks were then voted to the Lord Provost for his conduct in the Chair, and to the Gentlemen who signed the requisition for calling this meeting.

The following Gentlemen were appointed Members of Committee:—

The Lord Provost of Glasgow. The Provost of Paisley. The Provost of Dumbarton. Archd. Campbell, M.P. John Maxwell, M.P. John Buchanan, M. P. Henry Monteith, M.P. Kirkman Finlay. Robert Findlay. James Ewing. Wm. Smith. Robt. Dalglish, Dean of Guild. Wm. M'Tyer, Convener of Trades' House. Wm. Dunn. The Very Rev. Principal Macfarlan. Professor Jardine. H. Houldsworth. James Smith, Jordanhill. Bailie Browne. Charles Macintosh, Jas. Oswald. James Dennistoun. William

Hussey. Samuel Hunter. William Hamilton. Gilbert Watson. David Todd. James Cook. Colin Campbell, Possil. John Thomas Alston. John Thomson. Dr. Jeffray. Robert Aitken. William Perry. John Berry. Michael Rowand. Richard Duncan. David Laird. Wm. Mills. William Dixon. James Dunlop. James Farie of Farme. Colin Dunlop. Charles Tennant. John Geddes. Dr. Meikleham. Andrew Templeton. Duncan M'Arthur. Dr. Thomson. Dr. Andrew Ure. Robt. Thomson. Wm. M'-Gavin. Wm. Carlisle, Paisley. Herbert Buchanan of Arden. William Houstoun, Johnstone. Rt. D. Alston. Archd. Wallace. Stewart Smith. Dugald Bannatyne. Rt. Hinshaw. Jas. Cleland. Jno. Wright, jun. Wm. Rodger. Rt. Ferrie. Rt. Wallace, jun. David Napier. Wm. Corbett. Rt. Ure. Rt. Baird. Wm. Kelly, jun. Henry Dunlop. Alex. Wood. Aw. Liddell. Stephen Miller. John Hart. Thos. Longstaff. John Fulton. Wm. Lang. Jas. Lumsden. Thos. Edington. Rt. Hastie. Archd. M'Lellan, jun. J. B. Neilson. Rt. Napier. John Neilson. William Watson. Moses M'Culloch. William M'Andrew. Robert Murdoch. James Christie.

The following are a few of the Subscriptions:—H. Monteith, 105*l.* K. Finlay, 105*l.* William Dunn, 105*l.* Thos. Telford, 52*l.* 10*s.* James Ewing, 52*l.* 10*s.* John Gordon, 52*l.* 10*s.* James Fyfe, 52*l.* 10*s.* Mungo N. Campbell, 52*l.* 10*s.* Mrs. James Smith, George Square. 52*l.* 10*s.* Robert Muirhead, 26*l.* 5*s.* John Campbell, Lieut.-Col. H.E.I.C.S., 26*l.* 5*s.* H. Houldsworth, 26*l.* 5*s.* Charles Tennant, 21*l.* R. Dalglish, Falconer & Co., 21*l.* James Dennistoun, 21*l.* William Dixon, 21*l.* John Dixon, 21*l.* Robert Thomson, 21*l.* Proprietors of the Glasgow Herald, 10*l.* 10*s.* James Reddie, 10*l.* 10*s.* Dr. Thomson. 10*l.* 10*s.* Geo. Jardine, 10*l.* 10*s.* Thomas Edington, 10*l.* 10*s.* Rt. Findlay, 10*l.* 10*s.* R. D. Alston, 10*l.* 10*s.* Archd. Wallace, 10*l.* 10*s.* William Smith, 10*l.* 10*s.* Glasgow Courier, 10*l.* 10*s.* A. D. Campbell, 10*l.* 10*s.* J. M'Call, 10*l.* 10*s.* Wm. Hamilton, 10*l.* 10*s.* John May, 5*l.* 5*s.* David Sim, 5*l.* 5*s.* James Cleland, 5*l.* 5*s.* W. S. Northhouse, 5*l.* 5*s.* Robt. Ferrie, 5*l.* 5*s.* William Rodger, 5*l.* 5*s.* James Edington, 5l. 5*s.* Lockhart Muirhead, 5*l.* 5*s.* Mrs. Lockhart Muirhead, 5*l.* 5*s.* Miss Jane Campbell, 5*l.* 5*s.* A. M'Lellan, 5*l.* 5*s.* A. Smith, 5*l.* 5*s.*

CHEMICAL EXPERIMENTS.

To cause ignited Charcoal to burn splendidly.—If a piece of ignited charcoal be put into a small platinum spoon, and immersed in a jar of oxygen gas, combustion with great splendour will take place, and carbonic acid will be formed by the union of the two substances.—*Rational Recreations.*

A candle converted into carburetted hydrogen gas.—When a candle is burnt so low as to leave a tolerably large wick, blow it out; a dense smoke, which is a compound of hydrogen and carbon, will immediately arise; then if a lighted candle, or lighted taper be applied to the utmost verge of this smoke, a very strange phenomenon will take place: the flame of the lighted candle will be conveyed to that just blown out, as if it were borne on a cloud; or, more properly speaking, like a flash of lightning proceeding at a slow rate.—*Ib.*

NOTICES TO CORRESPONDENTS

Must be deferred till next week.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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THE GLASGOW
MECHANICS' MAGAZINE.

" As Life discordant elements arrests,
Rejects the noxious, and the pure digests;
Combines with Heat the fluctuating mass,
And gives a while solidity to gas;
Organic forms with chemic changes strive,
Live but to die, and die but to revive!
Immortal matter braves the transient storm,
Mounts from the wreck, unchanging but in form."—*Darwin.*

No. XLIX. *Saturday, 4th December,* 1824. Price 3*d.*

PLAN FOR CONSUMING SMOKE IN ENGINE FURNACES.

Invented by Mr. J. MAULE, Coldstream.

PLAN FOR CONSUMING SMOKE IN ENGINE FURNACES.

Invented by Mr. J. MAULE, Coldstream.

SIR,—The following simple plan for consuming smoke in engine furnaces, may be useful to many of your readers, and I think is worthy of general adoption. Improvements may perhaps be made upon it, but the principle being once suggested, there is in general no great difficulty in rendering it available in all those cases where the utility of the plan is undoubtedly a desideratum.

I am, SIR, your's, &c.

J. Maule.

Coldstream, 1824.

Description of the Figure.

A, A, A, A, is the furnace in which the boiler B, B, is placed. The smoke rising on all sides from the flame surrounding the lower part of the boiler, ascends to the top of the furnace, and escapes at C, the chimney of the furnace; whence it passes down the pipe E, leading from the furnace chimney to the valve F, of a pair of bellows, which is employed to throw back the smoke into the furnace A, A, A, A. These bellows are provided with another valve G, for the purpose of throwing in the common atmospheric air, which is necessary to produce the combustion both of the fuel and the smoke. The bellows may be also driven by the engine.

ON THE ADVANTAGES, THE INCONVENIENCES, AND THE COMPARATIVE DANGER OF HIGH, MEAN, AND LOW PRESSURE STEAM ENGINES.

(Extracted from the Report to the French Institute, by M.M. Laplace, Prony, Ampere, Gerard, and Dupin.)

THE subject resolves itself into the two following questions:

1. What are the relative advantages of mean and high pressure steam engines? and

2. What is the danger that attends them?

FIRST PART.—*Comparative Advantages of High Pressure Engines.*

Amongst the advantages of high pressure engines, that of occupying the least possible space must be enumerated, and will be the more important, as the space for their erection is more confined, or the ground more valuable: where manufactories, and private houses, are so crowded together that each establishment can obtain but a very limited space, and great power is at the same time necessary, this advantage is particularly felt; and it is no less important in the interior of mines, for the same reason.

A second advantage of high pressure engines, and one that is even greater than the former, is the economy of fuel which results from the effects of a high temperature. This will be readily granted, when it is stated that the repairs and expenses of the steam engines employed in draining a single large coal-mine in England, amounts annually to the sum of £25,500.

On this account several large proprietors of copper and tin mines, in Cornwall, adapted machinery to their engines, in 1811, by which an account is regularly kept of the work which they perform; and, from the results of these experiments, conducted on the largest scale, the comparative effect of the different kinds of engines has been ascertained for more than ten years.

In the month of August, 1818, the Cornish steam-engines raised

15,760,000 lbs. one foot high, for each bushel of coals consumed.

From December of the same year, the improvements were so material, either in the management of the engines, or in some of their parts, that the mean total product was increased to 17,075,000 lbs.

By a series of similar improvements, and by the construction of new and more perfect engines, the product was,

In Dec. 1812, 18,200,000 lbs.
——— 1814, 19,784,000
——— 1815, 20,766,000

and since 1815, the product is even still larger, in consequence of the improvements that have been made in the construction of the fire places, and boilers, and in short in every part of the machinery.

At the present day, it is calculated that Watt's improved steam engines raise more than 30,000,000 lbs. of water one foot high, by the consumption of one bushel of coals.

By the side of this augmentation we must place that which results from the employment of Woolfe's steam engines, which, as is well known, are condensing engines, and work with a pressure intermediate between that of the high and the low pressure engines.

Such a machine, with a double cylinder, has been constructed for the mine Whealvor, in Cornwall; the diameter of the large cylinder is 53 inches, and that of the small one 5.3 inches. This engine has raised 49,980,822 lbs. one foot high, by one bushel of coals, whilst the mean product of the other engines was only 20,479,850 lbs. raised to the same height.

In 1815 the mean product of two of Woolfe's engines was 46,255,250 lbs.

One of the inconveniences attending engines of mean and high pressure, is loss of power by the wear of the more delicate parts of their structure, and the consequent loss of steam; at the same time it must be admitted that the improvements in the construction of the steam vessels have materially lessened this serious evil.

The preceding statements respecting the Cornish steam engines, is taken from the reports published by Dr. Tilloch, in the Philosophical Magazine; and the more recent English Encyclopædias confirm the facts which have been stated.

Experiments made in France support the truth of these reports. MM. Girard and Prony have made separate comparative experiments on the power of low pressure engines, and the condensing engines of mean pressure on Woolfe's system, as improved by Edwards. They find that the latter deserves the preference, as to economy of fuel, though their results do not exactly agree as to the extent of the saving in this respect; their conclusions, however, tend to the same end, and their discrepancies are referable to peculiar circumstances.

Instead of estimating the power of a steam engine by assuming the vague and ill-defined *power of a horse* as unity, it would be better to assume a given weight, raised to a given height in a given time; as 100 weight raised one yard in a second, which might be called *a power.* The working force of the engine would thus be indicated by the number of *powers* it is equal to, which may easily be ascertained by loading the piston with a sufficient determinate weight, and marking the space it passes through, so loaded, in one second of time.

The tension of the vapour being measured by its relation to the pressure of the atmosphere, taken as unity, it must always be referred to the standard barometrical pressure of 30 inches, and the temperature of 32°.

According to the preceding details, it may be assumed as incontestible, that it is most economical to employ steam at such a temperature, that its tension shall be equal to that of several atmospheres; but it is not so easy to decide to what exact tension it should be raised; or what is the mathematical law which expresses the product of steam-engines' powers in the function of the temperature, and the tension resulting from it.

"We have hitherto," says the report, "compared low pressure engines only with those of mean pressure; we now proceed to compare them with high pressure engines, which, as is well known, act without condensation of the vapour.

"Mr. Trevithick, in England, and Mr. Oliver Evans, in America, are the persons who first made high pressure engines.

"In 1814, Mr. Trevithick exported to Peru nine of these engines, for the purpose of clearing the mines of water, from the accumulation of which many of the richest had been abandoned: so effectual were the engines, that the treasurer of the province proposed to erect a silver statue to Mr. Trevithick, as a memorial of the gratitude of the new world, for the services he had rendered.

"In Philadelphia, the saving in fuel by the substitution of one of Evans's high pressure engines for the low pressure one previously employed, amounted to about £1250 per annum. This engine raises 20,000 tons *(tonneaux)* of water, about 98 feet in height, every 24 hours, and consumes about 1535 cubic feet of wood per day. The prime cost of the machine was rather more than £5000; whereas, according to M. Marestier, a low pressure engine, of equal power, would cost considerably more than £8000.

"Evan's engines work with a pressure of from eight to ten atmospheres; several of them have been constructed in America; and in 1814, the Congress of the United States extended Mr. Evan's patent 10 years beyond the usual period, as an acknowledgment, on the part of the republic, for the benefit his invention has conferred on his country. A similar extension was granted in England, to Messrs. Boulton and Watt, for their condensing engines.

"More lately Mr. Perkins, an American, well known by his ingenious processes for employing steel plates instead of copper in engraving, has surpassed all his predecessors by the boldness of his conceptions. He employs, for his moving powers, steam under a pressure of more than 30 atmospheres, and apparently with great advantage.

"With respect to economy of fuel, we must, therefore, consider the high pressure engines, hitherto constructed, as not having attained the maximum. The use of condensed steam is yet in its infancy; and, notwithstanding the services it has already rendered us, we must consider them as far below what may still be expected, when we shall be more capable of availing ourselves of the full benefit of its effects."

(To be concluded in our next.)

ON THE DISCOVERY OF THE ABERRATION OF LIGHT.

Many attempts had been made by Astronomers, from Galileo to Bradley, to discover the annual Parallax of the fixed stars, or the amount of that change in the relative position of a fixed star and the pole, which ought to take place by the motion of the earth, from one point in her orbit

to another diametrically opposite. Their failure in determining this astronomical desideratum in proof of the Copernican system, fortunately did not deter others from attempting to discover it, and led to a more splendid discovery, than ever was anticipated from such a hitherto fruitless research. This discovery not only completely supplied the want of that desideratum, in as far as regarded the truth of the true system of the world, but it confirmed, in the most satisfactory manner, the discovery of Roemer, and made us acquainted with a new and interesting fact—namely, the aberration of light.

In order to detect the Parallax of the fixed stars, Mr. Molyneaux erected an instrument, about the end of November, 1725, and began his observations on a particular star, γ Draconis, on the 3d December, when the earth was near one extremity of the line of Apsides. It so happened, that at this time Dr. Bradley was on a visit to Mr. Molyneaux, and observing the same star on the 17th, found it more to the South, than the experiments of the former evening appeared to indicate. At first some inaccuracy was suspected in their observation, but on observing it three days after, the star was found still going South, although, at this time of the year, little or no Parallax should have been sensible, as the earth was in its lower Apsis. Continuing to observe the star, they perceived that in March, it was found to be 20″ South of what it had been originally, which was directly contrary to the change produced by Parallax. Astonished at facts so unexpected, nothing could as yet be done, except patiently to investigate the actual phenomena. By prosecuting their investigations, they found that from March it continued stationary, till the middle of April, when it began to proceed in a northerly direction, till September, and was then 20″ farther north, than it was in June, became there stationary, and then returned to the south, till in Dec. it had arrived at the spot where he originally saw it. These appearances could by no means be conceived to result from any parallactic change, being, in fact, in every respect, the reverse, and consequently the cause was to be sought for elsewhere. After many fruitless attempts to assign a sufficient reason for this change, in the position of a fixed star, it at last happily occured to him that the radius of this motion, was exactly the arc of the terrestrial orbit, through which the earth passed in the time which light took, (according to Roemer's experiments,) to come from the sun to our earth; and by following up this train of thought, he quickly perceived that the whole of the perplexing phenomena could be most satisfactorily illustrated and explained by the conjoint and simultaneous motions of the earth and light.

Thus, if we conceive the eye of an observer, immoveably fixed on a fixed star, which is also at rest, then he will always see it, in the direction of a line drawn from his eye to the object, no matter what the time be which light takes in passing over the intervening space. If, however, the star begins to move, the case is widely altered, and we then only perceive it in its real position, when the passage of the light is instantaneous; but the fixed stars being possessed of no sensible motion, any error which might originate from this source becomes entirely evanescent. If, however, the earth moves we figure to ourselves that which actually happens; and in considering this case, consider the phenomenon of the aberration of light.

This curious fact is illustrated in the best possible way by the

composition of forces, by far the most philosophical method, by which the effect arising from the simultaneous movements of light, and our planet can be explained, and upon which, indeed, any other explanation must radically depend. The fact may be enunciated in the words of the following problem:—

The aberration of light in a fixed star, near the pole of the ecliptic, amounts to 20″; it is required to determine from this observation, the velocity of light.

Let a ray of light, coming from a fixed star, pass over a certain space x, in the time that the earth passes over a space r, equal to the radius of her orbit, in completing a fourth part of her revolution. Complete the parallelogram rx, and draw its diagonal; then, it is evident, from the consideration of the well-known proposition respecting the parallelogram of forces or of motion, that the star from which the ray of light proceeds, will appear to the eye of an observer on the surface of the earth, in the direction of this diagonal. Now, since it is found by observation, that the aberration or the angle formed by the side x, and the diagonal, is 20″, by making the radius $r = 1$, we may find the comparative velocity of light. The circumference of a circle, whose diameter is unity, is $= 3.141592 6538979$, &c., and consequently the radius and semi-circumference are in the same proportion. Hence, if we divide 3.14159, &c. by 10800′, the number of minutes in 180°, the quotient will be the length of the arc of 1 minute. Therefore, $\frac{3.1415926538979}{10800'} = .000290888$-$2086657 =$ the arc of 1′.

Now it is evident, that the sines, tangents, and chords, of indefinitely small arcs, will be equal to the arcs *themselves*; and since the arc of 1 minute is only $\frac{1}{10,800}$th part of the semi-circumference, the length may be considered as the sine, &c. of that arc. Hence, the sine or tan. of $1' = .0002908882086657$; and since the sines, &c. of indefinitely small arcs are to one another, as the arcs themselves, the sine of 20″ will be equal to $\frac{1}{3}$ part of the sine of 1′. Therefore, the sine or tan. $20'' = \frac{.0002908882086657}{3} = .0000969627362219$. Now the tan. of the aberration : radius : : the radius of the orbit : x, the space passed over by the ray of light in the time the earth completes a fourth part of her revolution; that is, as tan. of 20″ : 1 :: 1 : x, or as .000096927362219 : 1 : : 1 : $10305 = x$. Hence the velocity of light is 10305 times greater than the earth's velocity round the sun.

Now taking the diameter of the earth as unity, its circumference will be 3.1416, and as 365 d. 6 h. = 525960 minutes. Therefore, the semi-circumference : the diameter : : the sine of half the earth's revolution round the sun : time of passing over a space = the diameter of her orbit. Hence 3.1416 : 1 :: 262980′ : $\frac{262980}{3.1416}$. But the velocity of light is 10305 times greater than this. Hence $\frac{262980}{3.1416 \times 10305} = 8.123 = 8'\ 7'' =$ the time in which light passes over nearly 200,000,000 miles. Consequently the velocity of light is $\frac{200,000,000}{8.123} = 24,620$-000 miles in a minute. And since the velocity of the earth in her orbit is $\frac{200,000,000 \times .3.1416}{525960} = 1192$ miles in a minute. The velocity of light is $\frac{24620000}{1192} = 20654$ times

greater than the velocity of the earth round the sun. And if, according to Bradley's observations, the annual Parallax of a fixed star does not exceed 1 second; then tan. $1''$ or, $\frac{.0002908882}{60}$: 1 : : 1 : 200,000 nearly. Hence the distance of the nearest fixed star is at least 400,000 times greater than the distance of the sun.

The effects which the aberration of light produces on the position of a star, always vary with its latitude. The change takes place always in the direction of the earth's motion; and when the star is in, or near the pole of the ecliptic, the longitude merely is affected; whereas, when the elevation is any angle whatever, the latitude is also then affected; and when the angle vanishes, the star never leaves the ecliptic, and is affected solely in relation to her right ascension and declination. Into the detail of those changes, it is unnecessary to enter, much less to assign the amount of the inequality, for any possible position, since the object in view is not a complete account of the phenomena of aberration, but merely in so far as they are connected with the velocity of light.

The aphorism of an ancient historian, " That many subjects which by nature are dark and uncertain, are rendered simple by patient investigation," may, with regard to the present one, be quoted with justice. To an illiterate man, the ingenious art by which the ingredients of the hardest bodies are at once detected, is an unintelligible enigma; and he stands aghast, when he is informed that the presence of iron is ascertained by means of a *re-agent*, which does itself contain the very body of which we are in quest, as an indispensible component. To the savage, the magic skill with which the enlightened European operates on numbers, far beyond the efforts of his puny imagination to conceive, verging even to infinity itself, is quite incomprehensible; and, lost in admiration and astonishment, he counts his fingers, the arrows of his quiver, till involved in the yet deeper labyrinths of amazement, he seizes his hair, or points to the trees of the forest, as substitutes for that which his mind cannot encompass. So it is with the present subject; till very lately, it might have been supposed that we were acquainted with no mode by which its rapidity of movement could be determined. Nevertheless, by two different processes, in no way connected with each other, we can ascertain, with any degree of precision, its real velocity; and when two methods, so incongruous, agree in producing an identical result, there surely cannot remain the slightest doubt in the mind of any man of common understanding, concerning the truth of a conclusion so unexpectedly deduced.

D.

DESCRIPTION OF THE CONSTRUCTION AND USE OF PLYMOUTH BREAKWATER.

PLYMOUTH Sound is very much exposed, and the heavy swell that is almost constantly rolling in, is much increased when the wind blows fresh from any point between south-east and south-west. In consequence, therefore, of the danger arising from the anchoring of large ships of war in a situation so entirely unprotected, it was necessary, during the latter part of the last war, for the fleet destined to watch the movements of the enemy at Brest, to seek for shelter in Torbay, when the tempestuous state of the weather would no longer permit them to

hover round that port. This circumstance led to an idea of improving the anchorage of Torbay, by affording it the protection of a breakwater; and a proposal was accordingly submitted to Lord Spencer, then at the head of the Admiralty, in the year 1799, by Mr. Whidbey. This proposal, although approved of by the noble Earl, was nevertheless lost sight of until the year 1806, when the idea of improving Plymouth Sound, by the erection of a proper breakwater, was suggested to Earl Grey, then first Lord of the Admiralty, by the late Earl of St. Vincent; and in the same year Messrs. Rennie and Whidbey were directed to survey the Sound, and to report on the possibility of affording a safe anchorage to ships of the line by the erection of such a structure.

This report, drawn up by two persons so eminently qualified, from their practical knowledge and experience, to investigate a subject of so difficult and complicated a nature, decidedly proved the possibility of protecting the Sound, and of making it a good harbour for at least fifty sail of the line. Unfortunately, however, from various changes in the ministry, those able reports and plans were neglected until 1811, when Mr. Yorke, then presiding at the Admiralty, resolved to carry the important work into immediate execution; and thus to secure to our fleets that security, and those advantages of position, which the glory and the safety of the British navy so essentially demanded.

The choice and situation of materials for the construction of the work was the next object of consideration. It was recommended as the most practicable and best mode of forming it, to sink very large blocks of stone in the line of the intended breakwater, allowing them to find their own base, and assume those positions which gravity would permit them; and that irregular masses of stone, from one and a half to two tons in weight, would be sufficiently heavy to resist the action of a stormy sea. The immense beds of limestone on the eastern shore of Catwater,* were found capable of producing blocks even much greater than the weight here alluded to, and this, together with the convenience of the shores for the loading of vessels, and the sheltered situation of the harbour, immediately pointed it out as the most eligible for the purpose.

On the 7th of August, 1812, the quarries were opened, Mr. Whidbey having been appointed to superintend the works in October of the preceding year. Five days after the opening of the quarries, the first stone was deposited in the Sound, amidst the acclamations of hundreds; and on the 31st of March, 1813, the Breakwater was first seen above the face of the sea, at low water of the spring tide. From that time the work has progressively advanced, and with so little ostentation and display, that the stranger wonders when he arrives in Plymouth, to find that a work, which ranks among the proudest of our national monuments, should be carried on with so much quietness and ease. At the present time, (July, 1823,) there have been one million eight hundred thousand tons of stone deposited.

The Breakwater consists of a central part of one thousand yards in length, and two wings, each of

* It is in these quarries that the caverns have been discovered containing the bones of the Rhinoceros, the Hyæna, and other animals, which have so much interested the geological world. The bones and caves are described in the *Philosophical Transactions*, and in Professor Buckland's interesting work, entitled, *Reliquiæ Diluvianæ*. See also the *Edin. Phil. Jour.* vol. ix. p. 225, 226.

three hundred and fifty yards, forming, with the middle portion, angles of 158°, the angular points being turned towards the ocean. At the distance of sixty fathoms from the eastern extremity of the central part, are the St. Carlos Rocks; and these, together with the Shovel Rocks, extend to 640 fathoms, so that considerably more than half the central part of the Breakwater rests on masses of rock, which at all times impeded the navigation of the Sound. The tranverse section is of the form of a trapezoid, whose base, on an average, extends to about 290 feet, its breadth at the top 48 feet, aud its average depth about 56 feet. The sloping sides of this trapezoid have different inclinations; that towards the harbour forming with the horizon an angle of 33°, and that towards the sea one of 22°, the stability of the structure being much increased by diminishing the inclination on the latter side. On the top it is proposed to build a pier, with breast-walls, and a light-house, at each extremity. The place of the latter is at present supplied by a light placed in a vessel, which is kept constantly moored at the western end of the works.

The average depth of water in the immediate vicinity of the Breakwater is 36 feet at low water spring tides; and it is carried in height above that to 20 feet, which is somewhat more than the general rise of spring tides in the port. On the central part of the top, the huge blocks are so arranged as to form a convenient path from one end to the other; and to which hundreds resort during the summer to enjoy the surrounding scene: the water covered with numerous boats presenting a changing picture of perpetual interest; and the land, rising into lovely hills, bounded on one side by the lofty summits of Dartmoor, and on the other slowly melting into the distant tors of Cornwall.

The quantity of limestone required for its construction, as originally estimated by Messrs. Rennie & Whidbey, amounted to 2,000,000 tons; and the probable expense to £1,171,100.

The blocks of stone are transported to the Breakwater in vessels of a strong and peculiar construction. They weigh, on an average, from three to five tons, and are placed on trucks at the quarries, and run down from thence, on iron railways, to the sterns of the vessels, which are turned towards the quays to receive them. Iron railways are also fixed on the deck and in the hold, for the purpose of receiving the trucks. A cargo consists sometimes of 80 tons, though frequently, on account of the weather, it varies to 60, and even 40 tons. Instances have been known, however, of cargoes of 80 tons being discharged in 40 or 50 minutes. By means of very powerful cranes, the stones, notwithstanding their great diversity of form, are so singularly accommodated to each other, as to call forth the admiration of the beholder.

The experience of eleven years has fulfilled the expectations of the warmest advocates of the Breakwater. The second year after its erection, its good effects were plainly perceptible; and every winter has increased the testimonies in its favour. In the early part of 1817, a decided proof was afforded of its benefit, by its sheltering the Sound and Catwater from the fury of one of the most tremendous hurricanes remembered by the oldest inhabitant. The water rose six feet above the usual height of the spring tides, and the most desolating effects must have ensued, if the raging of the ocean had not been checked by this noble structure. A fine though melancholy contrast was exhibited in the fates of the Jasper and Telegraph, which were anchored in a

part without shelter from the Breakwater, and a deeply laden collier lying under its protection. The former, though possessing every advantage that the cables and anchors of the king's service could afford, were totally wrecked; whereas the latter, with but feeble means, rode out the fury of the storm, and presented to the few, who might before that time have doubted of the efficacy of the Breakwater, a most convincing and undeniable proof of its advantages.

Another great work, connected with the Breakwater, is the noble reservoir at Bovisand, for the purpose of supplying the navy with water. It contains 12,000 tons, and the water is conveyed in iron pipes to Staddon point, a distance of 1200 yards, a great portion of which is a tunnel, cut through the high surrounding land.

OUTLINE OF Mr. MACFADYEN'S INTRODUCTORY LECTURE TO A COURSE ON NATURAL HISTORY.

After making some remarks on the origin of the science, and the slow but gradual progress with which it has advanced to its present state of perfection, the Lecturer proceeded to divide the objects it comprehends into two kingdoms, the Organic and the Inorganized. Mere speculative philosophers have, in all ages, delighted in pointing out an imaginary chain of being; crystalization being the link connecting minerals with plants, and the immense interval separating man from his Creator; being supposed to be filled up by various superior orders of intelligences. The incorrectness of this notion, the Lecturer satisfactorily proved, by pointing out the various important circumstances that distinguished organic from inorganized matter. The first argument he employed was, that whilst inorganic bodies were persistent, organic were liable to decay and death. While races of living beings pass away in rapid succession, and the flowers and the leaves only come forward to be withered before the inclement approach of winter, the hills and the rocks, which they overshadowed and adorned, remain the same. Yet we had no reason for believing that inorganic matter was indestructible. It is true, carry our eye into the present or the past, no appearance of the commencement or termination of the present order of things might meet our view. Yet we cannot doubt, but even as it had a beginning, so also it would have a close; "the hills, the mountains, and the rocks, vanishing and melting away, like the snow that once rested on their summit." As a second mark of distinction, he observed that the parts of inorganic matter, unlike those of organic, were independent of one another. The third was, that organic bodies, before enjoying a distinct existence, must have formed part of the body of another of the same kind. Inorganic matter, on the contrary, being exempted from decay, had no need for any such resource. The fourth characteristic of organic bodies was, that they alone were possessed of a common integument, or skin. Of any covering of this description, minerals are altogether destitute, their forms being preserved by the cohesive attraction of the different particles of which they are composed. In the fifth remark, it was noticed that inorganic matter is destitute of the principles of instinct and irritability. Plants, as well as animals, are possessed of both. In the former, instinct is displayed in their germination, the root descending into the soil, whilst the plumule

rises to form the stem of the future plant. Among animals, it may be detected in the young bird issuing from the egg, seizing, bruising, and swallowing, with all the dexterity of a confirmed habit, the food which a mother's tenderness has placed within its reach. The seventh and last distinctive character was, that whilst inorganic matter could exist under every possible circumstance, there were certain conditions, such as the presence of heat, moisture, air, &c. necessary for the existence of animal and vegetable life.

A line of distinction was then drawn between animals and plants. This was shown to be attended with some difficulty in the lower orders of animals, such as the polipi and the sponges. They might, however, be distinguished by the following marks: 1st. The solid parts of vegetables contain carbon, oxygen, and hydrogen, whilst those of animals are composed principally of limè and magnesia united, the carbonic and phosphoric acids. Hence they are readily distinguished from each other when burning. So also, in a state of decay, whilst vegetable matter passes into the acid fermentation, the soft parts of animals are disposed to become alkaline, the azote uniting with the hydrogen, and forming ammonia. 2d. Animals are distinguished by their structure, plants being destitute of a nervous system, and consequently deprived of sensation, voluntary motion, and locomotion. It was mentioned, that the only trace of sensibility the sponges displayed was their contracting on the removal of light, and being affected with a slight tremor on being touched. 3d. Animals alone possess a stomach and alimentary canal. This prevails throughout; the hydatids which are found in different parts of the human body being nothing more than a stomach or membranous bag.

A very interesting view was then given of the relation which the different departments of nature bear to one another. The conclusions drawn were, that the organic kingdom was dependent on the inorganized; that animals are dependent on vegetables for their nourishment; and that the different tribes, in each kingdom, have determinate mutual relations. Judging from their mode of action, it follows, that vegetables are inferior to plants, but superior to minerals, in the scale of being. Notwithstanding all the differences of character with which they may be marked, collectively they form one harmonious whole, in every part of which the traces of wisdom, beneficence, and power, are equally conspicuous.

Mr. M'Fadyen then entered, at considerable length, on the advantages of a knowledge of Natural History in the different arts and pursuits of life, such as mining, agriculture, &c. He then gave an interesting account of the many attractions which the science possessed. The first mentioned was the beauty of the objects in which the Naturalist was engaged. "In all the works of Creation," he observed, "the stamp of beauty was displayed; in the painted wing of the butterfly and the studdings of the coating of the beetle, as well as in the symmetry of the human frame, and the graceful curves of its muscular covering. Shall we then extol the imperfect productions of human art, and remain insensible to the finished chef-d'-œuvres of a Divine artist? May we gaze unblamed on an Apollo of Belvidere, and a Venus de Medicis, and on the paintings of a Raphael and a Titian, and can we behold, with less ecstacy, sculptures produced by the chisel of the Almighty, and the inimitable tints laid on by his pencil?" We were also struck with the con-

cluding passage, commencing with the address, " It is to thee, Spirit of Nature—thee, all-pervading, all-sufficing power, that we would ever turn," &c.

VARIOUS COMMUNICATIONS.

ON CHIMNEY CANS.

SIR,—In page 277, Vol. II. in which you have inserted my answer to Z., R. of Port-Glasgow, in his answer to the same queries, confirms what I have said concerning old wives. But I cannot agree with him in his sweeping condemnation of earthen cans. They are so far from being useless, that we find few vents go well without them, or some substitute for them. Vents without them are generally subject to sudden gusts of smoke during high winds; the wind being repelled by the building, rises with increased violence till reaching the top; it sweeps over the vents with a force that overwhelms the draught. Now, the cans being raised above the building, and there being a space between them, the violence of the wind is broken, and a part of it entering in at the bottom of the cap and guided upwards by the top of the can, forces a passage for the smoke through the wind that passes over the top, which, at times, would otherwise be impenetrable to the smoke itself. No doubt, old wives will answer all these purposes; yet where the common can will do, it ought to be preferred, as it is not so likely to go wrong, nor so troublesome when the vent is to be cleaned; yet, though I approve of the principle on which the earthen cans are made, I would have no objections to them being laid aside, and cast-iron cans, with flaunches, fixed to the stone with iron bolts and nuts, or forelocks, used in their stead, as it would add greatly to the safety of people walking the streets in windy weather.

Y. S. D.

Gorbals, Nov. 25th, 1824.

Query.—Is it not the duty of the Police to look after, and cause chimney cans that are loose, to be repaired? If it is their duty, how comes it to be so much neglected?

Y. S. D.

CHEAP AND EASY METHOD OF MAKING SODA WATER.

SIR,—The following is a cheap and easy method of making Soda Water in bottles. I have made it frequently, and find that it keeps good for a considerable time, provided that the bottles in which it is kept be made air tight.

Take forty grains of the carbonate of soda, put it into a common soda water bottle, which generally contains about ten ounces of water. Immediately afterwards, put into the same, thirty-five grains of tartaric acid, then cork it quickly. The acid and the salt ought to be put in in crystals, as when in powder they are apt to seize upon each other before the bottle can be *well* corked, and so a considerable quantity of the carbonic acid gas which is evolved, is lost.

In the above process, the tartaric acid having a greater affinity for the soda than the carbonic acid gas has, combines with it, and forms the tartarate of soda, a soluble salt. By this combination, the gas which was engaged with the soda, is evolved, or set free, and mixes with the water in the bottle, and makes its escape when the cork is withdrawn.

R. H.

Glasgow, Nov. 24th, 1824.

ON ROUND ROBINS.

SIR,—I was no less pleased than gratified in noticing such a well written and merited compliment paid you lately, in

the shape of a ROUND ROBIN, and signed by so many Gentlemen, some of whom I observe are ranked among the list of your respectable Correspondents.

Now, Sir, the intention of this is to present such of your numerous readers, as are ignorant of the origin of a ROUND ROBIN, with a paragraph, which, I think, will inform them. It is from an old Glasgow periodical of 1790, and now but very little known.

"It was customary among the ancients to write names, whether of the gods or their friends, in a circle, that none might take offence in seeing another's name preferred to their own. The Cordeliers have formerly been known to have paid the same attention to delicacy; and when a Pope has demanded the names of some Priests of their Order, that one might be raised to the Purple, they have sent those names written circularly, that they might not seem to recommend one more than another. The sailors are the only people who preserve this very ancient custom in its purity, for when any remonstrance is on foot among them, they sign it in a circle, and call it a ROUND ROBIN."

Your's, &c.

A. L——y.

Spring Bank, 18th Nov. 1824.

BAG-PIPES.

A Belfast Correspondent wishes to know the cheapest and best method of making a pair of Highland Pipes, and particularly the size of the Chanter and Drones.—A. L.

MONUMENT TO JAMES WATT.

MR. EDITOR,—It is with considerable diffidence I address you on a subject which interests Mechanics in general, and the Mechanics of this city in particular, to a very considerable degree, I mean the Monument proposed to be erected in Glasgow to the memory of James Watt. The fear of not doing justice to the subject, however, is the only cause of my diffidence, as I well know that no Mechanic in this city at the present moment, can think of this proposal but with the highest feelings of approbation, and my intention in addressing you, is to suggest the propriety of every Mechanic contributing his mite to this noble and praise-worthy object. We have all heard of James Watt; his name and his inventions are familiar to us; his transcendant worth, and his superior talents, are acknowledged by all. We have seen nobles and statesmen, men illustrious by birth and talent, men distinguished for their moral and intellectual endowments, all uniting in awarding to that eminent individual, that meed of praise, and that reward of fame, which are ever considered due to true genius by a grateful community. Shall we, then, who like him can boast of belonging to the enlightened Mechanics of this free country—shall we, I say, refrain from expressing our admiration and our esteem for such a distinguished brother Mechanic, by refusing to contribute, as far as we are able, to the erection of a monument to *his* fame, who, by his superior talents, has shed a lustre over our employments and our pursuits, and opened up a path to glory and renown, more ennobling than the sanguinary footsteps of the warrior, or the cunning and self-interested track of the politician? By no means! But if monuments have been reared to the memory of those who shed their blood in the defence of their country, or to those who have enlightened mankind by the splendid efforts of their intellectual genius, surely a similar memorial is justly due to him who has increased the wealth and resources of his country to an incalculable extent by his inventions, and who has laid open an ever increasing fund of internal strength and comfort to his fellow-citizens, and furnished a means of defence which, superadded to our national bulwarks, will not only render us invulnerable at home, but spread the terror of our arms and of our power, over every region of the habitable globe. And what Mechanic, after contemplating the vast and unceasing benefits which flow to the race from the invention of Watt, and the fame which has followed to the inventor, does not feel the glow of genius burn within his breast, and emulous of the example of his illustrious countryman, feel a noble desire to tread in his footsteps, though at a humble distance? Who knows but that some favoured individual in this very city, may, with such a brilliant example before his eyes, accomplish a similar invention, and confer both wealth and renown on himself as the author? The discoveries that have been

made within these last two hundred years, far surpasses in grandeur and importance all the labours of man for nearly 6000 years before that period, and who shall pretend now to limit the progress of the race, to the discoveries of the present generation? New fields of invention may yet remain to be explored, more splendid trophies may yet be hung up in the temple of science, and future Watts may yet arise in this, our native city, and reflect a cheering light on the walls of her Mechanics' Institutions. Anderson's Institution, of which I have the honour to be a member, has the DISTINGUISHED and UNDISPUTED HONOUR of being the parent of all the numerous Institutions that are now established in the Kingdom for the instruction of Mechanics; and it ought also to be the FIRST in doing homage to the memory of that departed worth, and talent, which was fostered by the very hand that laid its foundation. Yes, Sir, the very man that founded this noble Institution, 20 years before any similar one existed, was the friend and the companion of the illustrious Watt, and had not our venerable founder, Professor Anderson, required his assistance in a very small matter, the steam engine of Watt, and the consequent wealth and prosperity of our country, as well as the glory of this day, would never have had an existence. So true it is, that the dormant powers of genius require accident or circumstance to call them into operation, when otherwise they might never have been known. This idea has been beautifully expressed by Gray in the following lines:

"Perhaps in this neglected spot is laid
Some heart once pregnant with celestial fire,
Hands that the rod of empire might have sway'd,
Or waked to ecstacy the living lyre."

It is well known that the founder of Anderson's Institution, while Professor of Natural Philosophy in Glasgow College, was frequently in the habit of lounging in the shop of that illustrious Mechanic, which at that time was the resort of all the ingenious men in the city, and that he used to take great delight in his conversation and pursuits; and it is also well known, that the Professor sent him the model of an old steam-engine to be repaired, and that this was the very circumstance which led to his improvements and inventions on that machine. It is also worthy of remark, that this very Institution was, by the will of its founder, established for the benefit of the manufacturers and artizans of Glasgow; so that to Professor Anderson may be traced the origin of all those Mechanics' Institutions which have since arisen in Britain, an honour which has hitherto been ascribed to another individual. The friendship, therefore, which existed between those two eminent individuals, and the zeal they showed for the good of mankind, entitle them to our warmest gratitude, and should cause their memories to be cherished by the Mechanics of the parent Institution, and held in grateful remembrance by the community. The superior merit of the improver of the steam engine, calls for a separate memorial of his fame, and as long as this Institution exists, and continues to diffuse knowledge through a numerous, important, and intelligent class of the community, so long will the monument of Watt be looked upon with respect and admiration, by its members, and the names of the PROFESSOR and the MECHANIC, be handed down to the latest posterity, as the benefactors of their race.

W. G.

MECHANICS' CLASS, ANDERSON'S INSTITUTION.

AT a meeting of this Class on Wednesday evening, Mr. Archd. Burns in the Chair, the following Resolutions were proposed by the Committee, and unanimously adopted by the Members.

Previous to the moving of the Resolutions, the Chairman requested the attention of the Class for a short time. A few days ago, he said, a series of Resolutions had been passed at a very numerous and respectable meeting of the citizens of Glasgow; and as they referred to an object which must greatly interest this Class, he begged leave to read them.

After reading the Resolutions passed at the Meeting, held in the Town-Hall, for the purpose of raising a Monument to James Watt, Mr. B. observed, that from these Resolutions, as well as from the observations of the wealthy and scientific Gentlemen who proposed them, all classes of society were called on to aid to the extent of their abilities, an object so desirable, as the erection of a Monument, worthy of the high feeling of respect they must all feel for the memory of that illustrious Mechanic; and that no body of men were more imperatively called on to express their feelings than the Members of this Class. They must recollect that that spirit of liberality which endowed this Institution, in a great measure, took its rise from the intimacy of its venerable founder with Mr. Watt. Their worthy Lecturer, a few nights ago, took occasion to remark, that Dr. Anderson left

perty, by will, to the inhabitants of w, in consequence of having observed eat advantages which Artizans de- from a knowledge of science; the ior, when he wrote that observation *will*, had no doubt in view the extra- y discoveries of his friend. It was ssary for him (Mr. B.) however, to o these discoveries. From the spot ich he now stood, they had fre- heard the most minute details and e descriptions of his various discov- id inventions; and on this table that ood before them, had been often ex- the most beautiful models of that al engine, which was the greatest f his sagacity and ingenuity. In all, many of them must have listened elight to the eloquent language in his character and manners had been yed, and it would therefore be pre- ous in him to take up a subject in a here it had been so often ably handled. ged to make, in conclusion, only one ; that it was not long since the term iic, even in this very country, en- d as it now pretended to be, was a term of reproach, and, he believed, ould recollect passages in Shake- which would bear him out in his n. To Mr. Watt, however, we debted for rescuing that name from ium, and for rendering it as honour- itle as a man could possess. On id many other considerations, which, o the shortness of the time, he could rge upon, he trusted they would all the Resolutions which were about ad to them by their Secretary.— and continued Applause.)

The Secretary, Mr. Gardner, then read the following Resolutions, which were received with loud cheering, and unanimously adopted by the Members.

1. That the Mechanics' Class, Anderson's Institution, view, with feelings of the highest satisfaction, the result of the public meeting of the citizens of Glasgow, held in the Town-Hall, for the purpose of raising a Monument to the Memory of our Illustrious Countryman James Watt.

2. That this Class consider themselves called upon, in a particular manner, to contribute, by subscription, to the furtherance of such a praiseworthy object, because this Institution was the first in Britain which showed the great advantages that would accrue to the community by placing a knowledge of the Arts and Sciences within the reach of the Mechanic.

3. That for the purpose of testifying their admiration of Mr. Watt's genius, and their gratitude for the benefits which have resulted from his inventions, a subscription be immediately opened among the present and former Members of this Class, in aid of the Fund for erecting a Monument to his Memory in this City.

4. That subscriptions be received by the Committee of the Class, and by such persons, and at such places as they shall appoint, till the 1st of January, 1825; and that the amount subscribed, shall be then paid over to the Treasurer of the General Committee of this City for the above purpose, in the name of the Mechanics' Class, Anderson's Institution.

SCIENTIFIC INTELLIGENCE.

cal sounds produced by the combus- hydrogen gas.—Prepare a large ith materials to produce hydrogen l having a small tub with a stop- ed in it for the passage of the gas. an earthen or iron tube two feet alf long, and from one to two in- de. As the gas rushes out, set t, and bring the large tube two or inches over the small one. In conds, as the flame continues to very strange but pleasing sounds produced, which may be varied ng or depressing the large tube. *nal Recreations.*

tiful sublimation of benzoic acid up- anches of a Shrub.—Place a sprig of rosemary or any other garden herb in a glass jar, so that when it is inverted the stem may be downwards, and the sprigs supported by the sides of the jar: then put some benzoic acid upon a piece of hot iron, so hot that the acid may be sublimed in the form of a thick white vapour. Invert the jar over the iron, and leave the whole untouched until the sprig be covered by the sublimed acid, in the form of a beautiful hoar-frost.—*Ib.*

Method of Preserving Animal and Vegetable Substances.—This operation is to be performed by an exact combination of certain principles most wholesome and nutritive, and which indeed are contained in vegetable bodies themselves; that

is to say, not by means of any one principle, but by proportioning the farinaceous vegetable principle with the coagulative or mucilaginous one, and supplying such combination, by admixture, according as the quality of the substance or substances to be preserved may require. To be yet more particular; in order to preserve any vegetable which is in itself of a watery or deliquescent nature, a greater portion of farina and mucilage is required than for others that are more solid and readily disposed to dry. Let the substance to be preserved, for example, be a carrot or turnip, the preserving matter may be compounded of wheat or barley-meal, with a solution of any common gum or vegetable mucilage. The substances may be either preserved in a raw state, or previously boiled, or otherwise dressed, as their nature or occasion requires; but as the matters that may be preserved in this way, including the preserving ones, are innumerable and various, it is impossible that any uniform rule can be given. Thus any simple farinaceous vegetable matter, combined with a mucilaginous vegetable one, composes a preservative for other fresh vegetable or animal bodies, or parts contained in them, which are of a less fixed or desiccative nature. The substances being thus accurately prepared, are dried in a way similar to that by which maltsters dry their grain; that is, by stoves properly heated, or otherwise, as occasion may suggest. And, lastly, they are carefully put up into wooden boxes, or other close packages, for keeping and use.

Inflammation of Sulpheretted Hydrogen by Nitric Acid.—When a few drops of fuming nitric acid are put into a flask filled with sulphuretted hydrogen, the hydrogen is oxidized by the nitric acid, and the sulphur is disengaged in a solid form. If the flask be closed with the finger, so that the gas which becomes heated cannot escape, its temperature is raised so much as to produce combustion with a beautiful flame, and a slight detonation which forces the finger from the mouth of the flask. This experiment may be made without the least danger, with a flask containing four or five cubical inches of gas.—*Berzelius.*

Artificial Chalybeate Water.—If a few pieces of silver coin, (says Dr. Hare,) be alternated with pieces of sheet iron, on placing the pile in water it soon acquires a chalybeate taste and a yellowish hue, and in twenty-four hours flocks of oxide of iron appear. Hence by replenishing with water a vessel, in which such a pile is placed, after each draught we may obtain a competent substitute for a chalybeate spring.

Mercurial Vapour in the Barometer.—M. Billiet observes, that "for a long time past it has been known that during hot seasons mercurial vapour has formed spontaneously in the upper part of the barometer tube, which condenses in minute drops on its inner surface. It is sufficient for the observation of this phenomenon at pleasure to apply a small tin vessel, filled with ice, to this part of the tube for an hour or two. On removing the cooling vessel there may be perceived on the internal surface of the tube a dimness about six lines in diameter, and by means of a lens it will be found that this is nothing but a mass of minute globules of mercury attached to the glass, those in the centre being the largest. Hence arises the question, whether this vapour may not have some influence on the oscillations of the Barometer.—*Bib. Univ.* xxv. 93.

NOTICES TO CORRESPONDENTS

U. S. C. has forgotten us.—J. C. R. under consideration.—Many solutions of the Wine query we have received are erroneous; it is not so easily solved as our Correspondents imagine.—M. A., A. M. Dyer, W. C., J. A., A Country Dominie, D., Y. S. D. and Rusticus, have been received.

Errata in our last; p. 296, col. 1, line 39, for *shell* read *hand*, and col. 2, line 16, put the words *may be considered the sounding body* within a parenthesis.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of Steuart & Panton, Cheapside, London; and Edward West & Co. Edinburgh.

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THE GLASGOW
MECHANICS' MAGAZINE.

" Objects are but th' occasion, ours th' exploit."—*Young.*

No. L. *Saturday, 11th December,* 1824. Price 3*d.*

IMPROVED SELF-LOCKING COPYING MACHINE, &c.

Fig. 1.

Fig. 3.

Fig. 5.

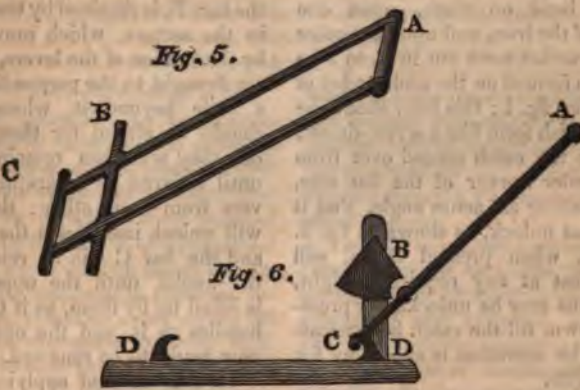

Fig. 6.

Fig. 8.

Fig. 7.

IMPROVED SELF-LOCKING COPYING MACHINE.

SIR,—Observing in p. 243 of your very useful Magazine, a very simple and ingenious Copying Machine, invented by Mr. C. North, who requests some of your correspondents to furnish him with a plan of locking it while under pressure, I beg leave to submit to you the following attempt, showing how this may very easily be accomplished, and also, to present you with what I conceive to be an improvement upon his plan.

Instead of making holes in the upright pieces of iron, for receiving the hooks at the ends of the levers, I would place studs, or pins, having a head on them, upon one edge of the iron, and upon the other edge, ratchet teeth cut in it, to take a catch formed on the under edge of the lever, fig. 1; this lever should be of a flattish form like a screw-driver, having the catch turned over from the under corner of the flat side, and making an acute angle, that it may not unlock, as shown at fig. 3. These, when pressed down, will hold fast at any required height, and thus may be unlocked by pressing down, till the catch be extricated. The operation is shown by fig. 2, p. 329.

By another mode, however, the machine might be made very powerful, and equally simple and convenient: thus let four upright pieces of iron be turned over the bottom, and well fastened, each having a sector of a circle, in the form of a strong bell crank, similarly fastened by a strong pivot, to the top of the upright iron, and turning freely thereon; let each sector have also a semi-circular notch at its outward angle, to receive the part B of the lever, see fig. 4, p. 328. Make the upper board to have two flat plates of iron running across it, at a third of its length from each end, and let each end of these plates be turned up at right angles, and formed into hooks, having the open part inwards, as seen at D, D, fig. 6. By this construction, upon these two plates of iron, the pressure is received from two levers, one of which is shown at fig. 5, where A is the handle, or purchase, and C the fulcrum; the projecting ends of C are received into the hooks on the upper board, and the still farther projecting ends of the bar, B, is received by the notches in the sectors, which move round by the motion of the levers, till they are brought to the perpendicular, or a little beyond it, where a stop should be placed for them to rest on; they will then remain locked, until relieved by separating the levers from each other; the bar B will unlock itself from the sectors, and the bar C will be retained by the hooks, until the upper board is lifted up by them, as if they were handles to it, and the operation is now ready to be renewed.

In this mode of applying the levers, the power increases with the resistance, as in the new printing press, described in one of your former numbers.

The bulk of the matter to press, may be adjusted by thin boards of wood, or pasteboard, or paper, placed in the bottom of the box. Fig. 7, is merely an end view of the press, while in action.

I am, SIR, your obdt. servt.

E. C.

Glasgow, 18th Nov., 1824.

A SAFE CANDLESTICK FOR BED-CHAMBERS.

SIR,—Some years ago I saw a safe and simple candlestick, for burning a light through the night in a sick chamber, &c. As it seemed to me very ingenious, and as I have never met with another, per-

haps it may not be generally known; if so, I here send you a description of it. It is nothing more than a tin funnel, fig. 8, a little longer and wider than the candle, having a ring of wire soldered near the top of the funnel, wide enough for the candle to pass easily through; the whole being filled with water, and the candle being put through the ring, it is by it kept floating vertically, until the candle gets so short that the bottom of it rises out of the tube into the funnel, where it has room to turn itself into its natural floating position, i. e. the horizontal; it then slips out of the ring, and the flame coming in contact with the water, it is instantly extinguished.

I am, SIR, &c.

E. C.

ON THE ADVANTAGES, THE INCONVENIENCES, AND THE COMPARATIVE DANGER OF HIGH, MEAN, AND LOW PRESSURE STEAM ENGINES.

(Extracted from the Report to the French Institute, by M. M. Laplace, Prony, Ampere, Gerard, and Dupin.)

(Concluded from page 308, Vol. II.)

SECOND PART.—*Measures of Safety.*

Habit reconciles us to danger. Hundreds of sailors perish annually by the power of the wind on the sails of our ships, and we think nothing of it, because we are become familiar to that mode of navigation. But if a *steam boat* be blown up, or burnt, the accident is reported in the public prints to every corner of the world; the alarm is given, and that is looked upon as the most dangerous of all mechanical powers, which perhaps is the least so in the common course of navigation, and especially on nearing the land.

But destruction in some shapes is more appalling to the imagination than in others. Death from explosions, accompanied with noise and confusion, seems more horrible than when it comes in a more tranquil form; and in all our discussions on the relative dangers of different machines, we should divest them of those accessary circumstances, which frequently produce the greatest effect on the minds of the vulgar and ill-informed.

Whenever man accumulates natural powers to effect certain purposes, they may, by mischance, be diverted from their proper courses, and become the cause of serious accidents; and no machine, by which those powers are concentrated, was ever constructed that has not its peculiar dangers.

To wish to employ only such machines as might be secure from the consequences of want of skill, imprudence, and rashness, were to wish to deprive ourselves of the happiest fruits of human skill and industry; at the same time it were a culpable neglect to suffer any man, for the sake of attaining an end of secondary importance, to employ means which might obviously endanger the lives and property of his neighbours. In such a case, public authority has a right to interfere, and exercise a beneficial and protecting influence.

Does this observation apply to steam-engines in general, or only to a particular class? Should the use of high and mean pressure engines be restricted to certain situations?

The British Parliament has lately taken this subject into serious consideration, and has adopted most of the precautions recommended by a Committee of the House of Commons, appointed to inquire minute-

ly into it, particularly with the view of obviating the dangers to which steam passage boats are liable from ill-constructed machinery, carelessness, or mismanagement. The Committee particularly recommended, that the boilers of the steam engines shall be made of wrought-iron or copper, and furnished with safety valves, of proper size and form, one of which shall be so secured as to be inaccessible to the workman who has charge of the engine: it also recommends that this valve shall be loaded only with such a weight that the pressure shall never exceed one-third of that, which the boiler has been found, by actual trial, to be capable of supporting without bursting, or one-sixth of its calculated strength; and that any person overloading the valve shall be liable to punishment.

Although the British Legislature has not forbidden the use of high pressure steam engines, either in passage boats or manufactories, the preference has been given, especially for boats, to low pressure engines; and much prejudice has been excited against the former from deplorable accidents which have occurred in America, in England, and France. Mr. Evans, however, according to Mr. Marestier, has defied his opponents to produce a single instance of the explosion of one of his engines, although they work with a pressure of 10 atmospheres.

But serious accidents are not confined to high pressure engines—they have happened with those of low pressure, both in England and America; and, more than once, explosions occasioned by the latter have been attributed to the former.

An account is given by Mr. Stevenson, in the Edinburgh Philosophical Journal,* of a dreadful explosion which occurred near Edinburgh, of a high pressure steam boiler; and in France accidents have happened both with low, mean, and high pressure engines, which require our particular attention.

Experiments, which have cost many person their lives, have happened with what are *called low pressure* engines, but which in reality cease to be such whenever the fire is strongly urged, and the escape of the condensed steam prevented, either by the accidental derangement of the safety valves, or by its being purposely overloaded. Amongst others, we may mention the deplorable accident which happened at Creusot, by which many individuals were killed by the bursting of the boiler of a *low pressure* engine. Let us turn to the other engines. At Peronne the balance beam of an English high pressure engine having broken, the steam in the cylinder drove up the piston and its rod through the planks and roof of the building in which it was placed; but no person was killed or hurt.

At Paris, the lower part of the boiler of a mean pressure engine having split, the water flowed into the fire-place, and put out the fire; the walls of the furnace were not even shaken, and no noise was heard except that of the rupture of the boiler. A similar accident occurred about three years since in another establishment, unattended by any more serious consequences.

But at Essonne, a more serious accident happened lately with a mean pressure engine, the boiler of which had been cast at a foundry not calculated for such work; and it has been satisfactorily proved, that the mischief was occasioned solely by the clumsy construction of the boiler, and the faulty manner in which its parts were put together.

It results, from all the details

* This boiler was erected for boiling the stills of the Lochrin Distillery, by *high* pressure steam.

which we have collected, that no mean or high pressure steam boiler, constructed in any regular establishment in France, has ever met with an explosion; although they are more numerous than those imported from foreign countries. During the last year six of these engines have been made in one manufactory at Paris, and a still greater number are making in the present year; and the more they are used the more they are approved of. Since 1815 more than 120 mean and high pressure engines have been made in the French manufactories.

Since 1815, 32 mean pressure engines have been sent to St. Quentin, from one manufactory at Paris; and the purchasers are universally well satisfied with the service they perform.

It became important to ascertain if the safety of the French engines, from their introduction to the present time, be merely owing to chance, or if it be the necessary consequences of multiplied precautions in their manufacture, and the previous trials to which the boilers are submitted. On this point the following information has been obtained respecting the cast iron boilers, which are considered as the most unsafe.

The mean pressure, condensing engines, on Woolfe's construction, are those which are made in the principal manufactory in France. With these engines the pressure may be varied from that of one atmosphere to two and a half, or three atmospheres, and is indicated by a mercurial gauge.

The true boiler and boiling pipes in Woolfe's engines (which must not be confounded) are made of the purest cast iron. The form of the boiler is cylindrical, its axis being horizontal.

The thickness of the boilers and boiling pipes of large and small steam engines, varies from about an inch and a quarter to an inch and three quarters. The diameter of the boiling pipes is much less than that of the boiler; for small engines it is less than half, for large engines less than one-third of the diameter of the boiler.

The axes of the boiling pipes are parallel to the axis of the boiler; they are placed below it, and immediately over the fire-place, in such a way that the flame is in contact with the pipes only.

As the boiler is less exposed to the fire than the pipes, it is less subject to injury from its action; and if any part give way from that cause, it is the lower part of the pipes and not the boiler; the consequence of which is the inundation of the fire-place, and extinction of the fire, as happened in one of the accidents mentioned above.

The parts of the engine are united with every possible attention to strength, and to closeness at the joints, so that there may be no loss of power from the escape of steam.

Before the pipes and boiler are used, they are separately submitted, by a hydraulic press, to five times the pressure that they will have to support when the engine is at work.

Before any conclusions are drawn from the preceding facts and observations, it may be well briefly to recapitulate them.

High pressure steam engines are employed with most advantage.

1st. Because the greater the compression of the steam, the less is the space the engine occupies.

2d. Because it produces an equal power to that of a low pressure engine, with a smaller quantity of fuel.

But they are considered as more dangerous than low pressure engines. Nevertheless engines may be constructed, with which explosions, if not absolutely impossible, are at least extremely rare; and

with which not a single instance of an explosion has occurred in France, since they have been used in that country.

Such are the mean pressure engines, of three or four atmospheres, made in France, on Woolfe's construction, as improved by Edwards, with boilers 4 or 5 times stronger than can be burst by the force of the steam which they have to resist.

Such also are the high pressure engines of 10 atmospheres, constructed on the plan of Oliver Evans, of the United States of America. With these engines the boiler is capable of resisting ten times the force it is daily subjected to.

But engines constructed with less care, or managed with less prudence, have occasioned dreadful accidents, especially in Great Britain.

In France only one accident has ever happened, by which any lives were lost, which were those of two individuals engaged in the service of the engine; and not one single instance has occurred in that country, in which any damage has been sustained by any individuals, from the explosion of a steam engine on the adjoining premises.

Although it appears, from the preceding statement, that no one in the neighbourhood of a steam engine, in France, has ever suffered either in his person or property from any explosion, yet the impossibility of such consequences has not been proved; and the bare apprehension of the danger is a real evil, attendant on the erection of a mean or high pressure steam engine in the neighbourhood of a dwelling-house. To reduce that apprehension as much as possible, the following precautions should be adopted.

1. Every steam engine boiler should be furnished with two safety *valves, one of* them inaccessible to the workman who attends the engine, the other under his command, in order that he may be able to diminish the pressure on it, as occasion may require. If he attempt to overload this valve, it will have no effect, since the steam will find vent through the other, which is out of his reach.

The reporter, M. Dupin, suggests in this place, that if any apprehension of danger be entertained, from the possibility of the inaccessible valve becoming fixed by rust or negligence, it may be obviated, by fixing in the upper part of the boiler two plugs of fusible metal, formed of such an alloy, as to melt at a few degrees above the working temperature of the steam. One of these plugs is to be considerably larger than the other, and to be made of a less fusible alloy, so that if the steam does not escape with sufficient rapidity on the fusion of the smaller, it may have made ample room to fly off, as soon as the larger has given way. The temperature, at which the least fusible alloy melts, must of course be considerably below that at which the increased elasticity of the steam would endanger the safety of the boiler.

2. All the boilers should be proved by being submitted, by means of the hydraulic press, to four or five times the working pressure, for engines that work with a pressure of from two to four atmospheres. Beyond that term the proof pressure should as much exceed the working pressure, as the latter exceeds the simple pressure of the atmosphere.

3. Every steam engine maker should be obliged to make known his method of proving the boilers, as well as whatever may guarantee the solidity and safety of his engines, especially as regards the boiler and its appendages. He should also declare this working

pressure, estimated by the number of atmospheres, or in pounds, on each square inch of surface exposed to the action of the steam.

4. For further security, the boilers of very powerful engines, when near a dwelling-house, may be surrounded by a thick wall, at the distance of between three and four feet from the boiler, and at least as far from the party wall of the adjoining house.

Lastly, if an exact account were taken, and published by the proper authorities, of all accidents that happen to steam engines of every kind, minutely detailing both the causes and effects of such accidents, with the names of the proprietors, and makers of the engines, it would tend to render unfrequent, though it cannot wholly obviate the evils that may arise from the use of mean and high pressure engines.

SKETCH OF THE HISTORY OF PHILOSOPHY,

Particularly with reference to Mathematical and Mechanical Science.

(Continued from page 282, Vol. II.)

BESIDES his astronomical discoveries which brought such unmerited persecution upon him, Galileo was the first who made any important advances in Mechanics from the time of Archimedes. He gave, in his treatise on that subject, published in 1592, the theory not only of the lever, but also of the inclined plane and the screw; and he first enounced and illustrated the following general propositions; that mechanical engines make a small force equivalent to a great one, by making the small force move over a greater space in the same time than the greater force, and in exact proportion to these forces; and that no contrivance can make a small weight put a great one in motion, but that which gives to the small weight a velocity, which is as much greater than that of the large weight, as the large weight is greater than the small one. He also showed, that, if the effect of a force be estimated by the weight it can raise to a given height in a given time, this effect can never be increased by any mechanical contrivance whatsoever. He also states in the same work the following proposition, that the effect of one heavy body to turn another round a centre of motion, is proportional to the perpendicular drawn from that centre to the *vertical passing* through the body, or in general to the direction of the force.

Galileo next extended the theory of motion, to the descent of falling bodies, and discovered the very important fact, that heavy and light bodies fall to the ground from the same height in the same time, or in times so nearly the same, that the difference can only be ascribed to the resistance of the air. Having observed the vibrations of lamps suspended by a string, he was induced to make some experiments and calculations, which led to the very important conclusion in Mechanics, that the great and small vibrations of the same pendulum are performed in the same time, and that this time depends only on the length of the pendulum. He found that the acceleration of falling bodies is uniform, or, that they received equal increments of velocity in equal times, and showed by mathematical reasoning, that the spaces descended through must be as the squares of the times, and that the space fallen through in one second, is just the half of that which the body would have described in the same time, with the velocity last acquired.

From the properties of the inclined plane, with which he was acquainted, he was led to conclude, that a body descending on it, must

be uniformly accelerated, though more slowly than when it falls directly, and is accelerated by its whole weight. By means of this observation, he was enabled to reduce the whole theory of falling bodies to the test of experiment, and to demonstrate the uniformity of their acceleration. He next proceeded to ascertain the path of a heavy body projected obliquely from the surface of the earth, and found it to be a parabola; this was the first instance of the principles of the composition of motion, which was afterwards generalized by Newton, and applied to the motions of the heavenly bodies. The theory of the inclined plane led to the knowledge of the proposition, that if a circle be placed vertically, the chords of different arches terminating in the lowest point of the circle, are all descended through in the same space of time.

Numerous and splendid as the discoveries of this philosopher were, we can form but an imperfect idea of his genius by their mere enumeration. The reasonings and the train of thoughts for which his works are remarkable, can only afford a just knowledge of the sagacity, penetration, and comprehensiveness of his mind. Not only the truths which he discovered, but the errors which he detected and exposed, shed a light on science, which not only tended to establish it on sound principles, but had a most powerful and salutary effect in overthrowing those that were false and absurd. His acuteness was strongly displayed in the skill with which he refuted the erroneous opinions of his adversaries, by comparing one part of them with another, and showing their manifest inconsistency. It is peculiarly, indeed, the praise of Galileo, that of all the authors who appeared in an age just emerging from ignorance and barbarism, he alone possesses the tone of true philosophy, and his writings are free from the contamination of the peculiar taste and opinion of the times in which he lived. Galileo made his discoveries in Mechanics at a very fortunate period, as they were rendered more interesting by those which he made at the same time in Astronomy. The system of Copernicus had, by this coincidence, an influence on the theory of motion, and consequently on all departments of natural philosophy. The *inertia* of matter might indeed have still been an unknown principle in nature, had it not been forced on the attention of philosophers by the discovery of the motion of the earth. The Italian Geometer, Torricelli, was the first who made any addition to the discoveries of Galileo. To him we owe the discovery of the following remarkable property of the centre of gravity, and general principle respecting the equilibrium of bodies. If there be any number of heavy bodies connected together, and so circumstanced, that by their motion their centre of gravity can neither ascend nor descend, these bodies will remain at rest; a proposition of the greatest utility in the resolution of difficult questions in mechanics.

(To be continued.)

Fig. 4.

(*For Description*, see page 322.)

Fig. 2.

(*For Description, see p.* 322.)

HISTORICAL ACCOUNT OF THE ORIGIN AND CONSTRUCTION OF STEAM ENGINES.

HERO'S ENGINE.

THE elasticity of the vapour of boiling of water, or what is now called steam, appears to have been known at a very early period in the history of mechanical invention. A Greek Mechanician, of the name of Hero, who flourished at Alexandria, in the reign of Ptolemy Philadelphus, about 130, B. C., was the first, according to the ancients, who employed steam to produce motion. The machine which he contrived for this purpose was abundantly simple, and consisted merely of a cauldron, or heated vase, closely covered with a lid, and having a pipe inserted at one side of it, which extended in a perpendicular direction above the vessel, and then was bent at right angles, when it terminated in the circumference of a hollow globe; this globe was made to move freely on the bent end of the pipe, and was equally supported by a similar pipe, proceeding from the opposite side of the vessel, and terminating in a pivot, moving also freely in a point on the surface of the globe, exactly opposite the former. From the upper and lower sides of the globe, proceeded two very short bent tubes and open; as soon as the water in the cauldron was converted into steam, it issued with considerable *velocity up through* the vertical tube, and then into the globe; but the globe being soon filled, it began to issue in like manner, both from the upper and lower bent tubes in the globe, causing it, by its rapidity and force, to produce a rotatory motion, and to seem as if (in the language of the inventor) it were "actuated from within by a spirit." Simple as this machine appeared to be, yet the very fact, that it produced motion by means of such a rude and unskillful mechanism, might have led, one would think, to more important applications than there is reason to believe ever were attempted; and although no practical use was afterwards made of it for many centuries, that we can learn, there is not a doubt but that this was the first steam engine, and that Hero was its inventor.

All the ancient authors, either prior or posterior to this writer, are perfectly silent on the subject of the elasticity of steam, or its effect in producing motion; but whether the knowledge of its properties should be ranked among the *lost* arts of the ancients, or whether there might not have been some treatise on the subject, which suffered at the general conflagration of the works of ancient learning, we leave those who are fond of speculation to determine. Nothing appeared on steam, so far

as we can learn from the works that have escaped the ravages of time, till the year 1563, in a volume of sermons by one Mathesius, who suggests the construction of an apparatus, similar in properties and operation to some of the more modern steam engines.

GERMAN ENGINE.

In the year 1597, a work was published at Leipzig, which contained a description of a machine, called the "whirling oelipile," very useful, as the author says, for turning the spit for the cook, and saving both the expense and the trouble of keeping a turnspit. This machine consisted of a hollow globe, supported on two uprights, and made to move easily by means of two short arms, projecting from the globe diametrically opposite each other, inserted in two holes near the tops of the uprights. A quantity of water being introduced into the globe, under which a fire was made, the steam issued from two small apertures in the end of two short pipes, placed also diametrically opposite each other, and so situated as to allow the globe to revolve freely by the force of the steam issuing at the apertures, without their coming in contact with the uprights, or the fire placed below it.

DE CAUS'S ENGINE.

An eminent French engineer and mathematician of the name of De Caus, who flourished in 1624, was the next who described an engine which acted by the elastic power of steam. It consisted of a spherical vessel, placed over a fire, having two apertures in the upper part; into the one was fitted a pipe, having a stop-cock and funnel, which supplied the vessel, or boiler as it may be called, with water; into the other a pipe was inserted, which descended into the water, till it *nearly touched* the bottom of the vessel, and was extended to any convenient height above it. When the water became heated, the increased bulk of the vapour forced the water in the vessel up the pipe, and caused it to issue in a jet at the top, according to the pressure which it sustained. De Caus appears to have been aware of the fact, that steam could be condensed into its own weight of water again, but he did not make any use of this principle.

BRANCA'S ENGINE.

In the year 1629, a treatise on machines was published by an Italian mathematician of the name of Branca, in which the first application of the power of steam to practical purposes was proposed, and appears to have been effected. His contrivance consisted of an oelipile or boiler, in the form of a negro's head, in the mouth of which was placed a pipe, from which the steam issued, and exerted its force upon a wheel placed horizontally, having float-boards or vanes, like a water-wheel or windmill, and thus produced a rotatory movement. This wheel, by intermediate wheels, pinions, or other mechanism, gave motion to the stampers of a mill for pounding drugs, &c., and was obviously applicable to various other useful purposes. On account of this machine, Branca has been considered by his countrymen as the inventor of the steam engine; to this merit, however, it is obvious that he has no farther claim than that of extending the idea furnished by the individuals we have already mentioned.

AIR ENGINES.

The elasticity of steam, which had thus been suggested by philosophers, had now become familiar to contrivers of water-works, and by them began to be applied to their favourite problem of raising water

above its level, in jets and fountains. Great effects were said to be produced by machines containing water exposed to the sun, which, by proper contrivances, was raised in tubs, and made to play in jets of various forms. Water was put into close vessels connected with a cistern, by means of pipes, and as soon as the sun heated these vessels, the vapour within pressed on the surface of the water, and caused it to rise in a tube, furnished with a valve, in the form of a perpetual jet; as soon as the sun disappeared at night, however, the vaporization stopped, the valve in the tube fell, and the water in the cistern rushed into the close vessels, by means of the pipes, to fill the vacuum. On the return of the day, and the sun, the same process was commenced, and thus continued for an indefinite period. The effects of these machines was increased, and higher and more numerous jets were said to be obtained for ornamental fountains, by inserting lenses or burning glasses in the tops or sides of the close vessels, so as to increase the heat of the sun. It is obvious that such machines could not be employed in this country, where the sun shines with such moderate warmth, and the inventor seems to have had our northern situation in view; for he says that his machines are only adapted for "those places where the sun shines with the greatest heat, such as Spain and Italy, and even there, they succeed best in summer."

The first English author who mentions the possibility of moving a machine by the elastic force of steam, is the learned and ingenious Bishop Wilkins. In the following passage of the Mathematical Magic, published in 1648, indeed, he evidently alludes to the machines we have formerly described, especially that of Branca. Speaking of producing motion by wind or air, "something of this nature," says he, "are the oelipiles, which are concave vessels, consisting of some such material as may endure the fire, having a small hole at which they are filled with water; and out of which, when the vessels are heated, the air doth issue with a strong and lasting violence. These are frequently used for exciting and contracting of heat in the melting of glasses. They may also be contrived for sundry other pleasant uses; as for moving of sails in a chimney corner; the motion of which sails may be applied to the turning of a spit or the like." From this curious passage, it would appear that the engine of Branca, in some form or other, was not only known, but made use of in various ways in England, at the time that he wrote.

MARQUIS OF WORCESTER'S ENGINE.

The origin of the steam engine has, however, been generally ascribed to the Marquis of Worcester, who lived in the reign of Charles the II., and published, in 1663, a work, which is well known under the name of the "Century of Inventions." The 68th article of this century, is that on which his claim to the invention of the steam engine has commonly been considered to rest. It is as follows: "I have invented an admirable and most forcible way to draw up water by fire; not by drawing or sucking it upwards, for that must be, as the philosopher calleth it, *infra sphaeram activitatis*, (within the sphere of its activity?) which is but at such a distance; but this way hath no bounder, if the vessels be strong enough. For I have taken a piece of a whole cannon, whereof the end was burst, and filled it three quarters full of water, stopping and screwing up the broken end, as also

the touch-hole, and making a constant fire under it; within twenty-four hours it burst and made a great crack. So that, having a way to make my vessels, so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a constant stream forty feet high. One vessel of water, rarified by fire, driving up forty of cold water, and a man that tends the work, has but to turn two cocks; that one vessel of water being consumed, another begins to force and refill with cold water, and so successively; the fire being tended and kept constant, which the self same person may likewise abundantly perform in the interim between the necessity of turning the said cocks."

A variety of opinions have been given respecting this passage, which, to say the least of it, is obscure enough, some maintaining that the idea of a steam engine is distinctly conveyed in it, and others affirming directly the contrary. Professor Robison says, that "this account, although by no means fit to give us any distinct notion of the structure and operation of his engine, is exact, as far as it goes, agreeing precisely with what we know of the subject." He afterwards adds, however, that it could instruct no person who was not sufficiently acquainted with the properties of steam, to be able to invent the machine himself."

(To be continued.)

SPECIMEN OF THE ALGEBRAIC EXERCISES

Performed by the Students of the Mathematical Class, Anderson's Institution.

(Continued from page 285, Vol. II.)

Equations,

Solvable by Multiplication.

1. Divide the number 75 into two such parts, that three times the greater shall exceed seven times the less by 15.

Let $x =$ the greater part,
Then $75 - x =$ the less part;
Hence, $3x = 7(75 - x) + 15$, per question.
Or, $3x = 525 - 7x + 15$, whence
$3x + 7x = 525 + 15$ by trans.
Or, $10x = 540$, whence
$x = 54$, greater part,
and $75 - x = 21$, less part.

2. Two boards are equal in area; the breadth of the one is 18 inches, and that of the other 16 inches, and the difference of their lengths is 3 inches; required the length of each and area of both?

Let $x =$ the length of the one,
Then $x + 3 =$ the length of the other; hence, $18x = 16(x + 3)$ *per question.*
Or, $18x = 16x + 48$, whence
$18x - 16x = 48$ by trans.
Or, $2x = 48$, whence
$x = 24$, length of the one,
and $x + 3 = 27$, do. of the other;
Therefore, $18 \times 24 = 16 \times 27 = 432$ area of each.

3. Six gamesters A, B, C, D, E, and F, sat down to play with the following sums on the table: A, £68; B, £73; C, £83; D, £86; E, £84; and F, £61. A constable happening to make his appearance amongst them, each of the fellows seized as much as he could, and made his escape. When they met again, after the hurry was over, it appeared that if each were to give up the following parts of what he had seized in the scramble, namely, A $\frac{1}{2}$, B $\frac{2}{3}$, C $\frac{3}{4}$, D $\frac{4}{5}$, E $\frac{5}{6}$, and F $\frac{6}{7}$, and the amount were equally divided among them, then every man would have his own money again; how much did each man seize?

Let $x =$ the share each person receives of the money given up by the whole.

Then, per question.

$(68-x) \times 2 = 136-2x =$ A's seiz.
$(73-x) \times 3 = 219-3x =$ B's do.
$(83-x) \times 4 = 332-4x =$ C's do.
$(86-x) \times 5 = 430-5x =$ D's do.
$(84-x) \times 6 = 504-6x =$ E's do.
$(61-x) \times 7 = 427-7x =$ F's do.

$£455 = 2048-27x =$ whole seizure; but

$27x = 2048-445 = 1593$, by transposition;

whence $x = 59$, the share required.

Consequently, by substituting this value of x in the above expressions, we have

		£
$(68-59) \times 2 =$	$9 \times 2 =$	18 A's sz.
$(73-59) \times 3 =$	$14 \times 3 =$	42 B's do
$(83-59) \times 4 =$	$24 \times 4 =$	96 C's do
$(86-59) \times 5 =$	$27 \times 5 =$	135 D's do
$(84-59) \times 6 =$	$25 \times 6 =$	150 E's do
$(61-59) \times 7 =$	$2 \times 7 =$	14 F's do
		£455 Proof.

Equations solvable by Division.

1. A person in play lost a fourth of his money, and then won back 3*s*. He again lost a third of what he now had, and then won back 12*s*. Lastly, he lost a seventh of what he then had, and found he had 24*s*. remaining; what had he at first?

Let $28x =$ money at first.
$\frac{1}{4} = 7x$ ... lost.
$21x + 3$ ... won, &c.
$\frac{1}{3} = 7x + 1$ ... lost.
$14x + 2$
12 ... won.
$14x + 14$
$\frac{1}{7} = 2x + 2$ ... lost.
$12x + 12$ ... remaining.

whence $12x + 12 = 24$ per question;

or, $12x = 12$, and $x = 1$;

Therefore, $28x = 28s.$ money at first.

2. It is required to divide the number 90 into four such parts, that if the first be increased by 2; the second diminished by 2; the third multiplied by 2; and the fourth divided by 2; the sum, difference, product, and quotient, shall be all equal.

Let $x =$ the equal result, then per question,

$x - 2 =$ first part.
$x + 2 =$ second do.
$\frac{x}{2} =$ third do.
$2x =$ fourth do.

and $4\frac{1}{2}x = 90$ per question;
or, $9x = 180$,
whence, $x = 20$,

Consequently,
$20 - 2 = 18$, first part.
$20 + 2 = 22$, second do.
$\frac{20}{2} = 10$, third do.
$20 + 2 = 40$, fourth do.

3. A person has two horses and a saddle, worth £50; if the saddle be put on the first horse, it will make its value double that of the second; but if it be put on the second, it will make its value triple that of the first; what is the value of each horse?

Let $2x =$ value of the first horse,

Then, $\frac{2x + 50}{2} = x + 25 =$ value of the second horse,

and $x + 25 + 50 = x + 75 =$ triple the value of the first horse; whence $2x \times 3 = 6x = x + 75$, and $5x = 75$; therefore $x = 15$.

Consequently, $2x = 30$, value of the first horse,

and $x + 25 = 40$, value of the second horse.

(To be continued.)

ON THE MEANING OF *INERTIA* AS APPLIED TO MATTER.

Of the phenomena of nature, it may with safety be affirmed, that a very great proportion are owing to motion, or that affection of matter, by which it changes from one place to another. It must be evident, therefore, that to have clear notions of the nature and properties of motion, is essential for all who engage in the study of nature.

The doctrine of motion rests on several general properties of matter, one of the principal of which is Inertia. Inertia, as ascribed to matter, signifies a passive principle in matter, by which bodies persist in their motion or rest, receive motion in proportion to the impressing force, and resist as much as they are resisted. Every change, according to this definition, implies the action of some external impulse, which we call *Force*, and which denotes that unknown cause producing a change in the state of a body as to motion or rest.

The one of these changes in the state of a body, viz. that from rest to motion, is the more definite of the two, and is therefore more easily admitted, since we are aware that it is caused by some force. But, that a body will continue to move for ever uniformly forward in a right line, until it is acted upon by some external force, is not quite so evident. We are, however, certain, that it is the case upon a little consideration, for our constant experience teaches us, that whenever a body moves in any other direction than a rectilinear one, there is some secondary power which causes it to deviate from this course. This is certain, from the fact, that in every case the deviation is exactly proportional to this secondary power.

From our knowledge of the causes which tend to destroy the motions of bodies, such as those that are to be met with in our common experience, and by which motion, in a contrary direction, is communicated to bodies, we are entitled to conclude, that, any deviation from uniform motion, or rather from the first direction and velocity in a body, is caused by some external force. When, farther, we can show, that by removing, or at least lessening some of these obstructions, the motions become more uniform, until even in some cases the deviation is scarcely visible, we are entitled to conclude, that there is no tendency in matter itself, either to increase or to diminish any motion impressed upon it.

For, although resistance in matter is certain, and real force exerted, yet it is no action in matter, nor is matter active in exerting it; and we may rather consider it as reaction, since it is never exerted until matter is first acted upon. From this, it is evident, that in no case does matter effect a change in itself, either of motion or of rest. It has a *force*, so to speak, to remain inactive, and it has this force equally in a state of rest or of motion; for we have seen above, that a body of rest has no power to put itself in motion, and, consequently, that without any impulse, it will not move at all; and we have also seen, that when in motion, it has no power to stop itself.

Every motion which we institute is constantly exposed to a succession of forces, which, although when taken singly, are trivial and incapable of producing any important retardation, yet when combined and taken collectively, present considerable opposition. Although we cannot wholly remove these retarding forces, we may lessen them to such a degree as to render them almost wholly imperceptible; and where we cannot effect this, we can, by means of calculations, determine the quantity of resistance.

Thus, in the case of a body projected perpendicularly upwards, with a velocity which would, independently of gravity, cause it to ascend a certain number of feet *per second*; it will, in consequence of the action of gravity, have its velocity greatly diminished. So accurately can we ascertain indeed, the greatest height to which a body will ascend, when thrown upwards with any given velocity, that it is only necessary to find the space through which a body must fall to generate that velocity, and the time it would be in descending through that space, which will be precisely the same as the height through which it will ascend, and the time of its ascent.

The existence of Inertia, in the case of man or of animals, says a writer upon this subject, may be doubted by a novice in philosophy, since we perceive that they can easily move themselves when at rest, and when in motion can with equal ease stop; but this must be accounted for from the fact, that a general impulse is received in these cases, at the commencement of life; and that all the actions of man or of the inferior animals, are the consequences of this original impulse. The

origin, dependence, and modifications of this original impulse cannot be ascertained by us; our faculties are, indeed, of too limited a nature to explain it in any way.

In fine, matter resists either by its internal constitution, as it is a solid extended substance, or by something external. If it resists in the latter way, it is from the impulse of other matter, but it must resist internally, or the impulse will produce no effect. It is evident, therefore, that Inertia is inseparable from matter, and must be an essential property of it.

D.

ON THE DISTINCTION BETWEEN UNIFORM MOTION AND UNIFORMLY ACCELERATED MOTION.

In uniform motion, the velocity undergoes no change, that is, the space passed over, and the time in which it is passed over, continue uniformly the same; the velocity always bringing before us a measure of length, proportionate to that of the time. The velocity then undergoes no change, and is constant; but it is by no means incompatible with uniformity of motion, that the direction, or the line of action, should undergo a change. But, in what manner is the velocity or direction of uniform motion produced? It is produced by a single impulse, or the action of any mechanical force. A body at rest would necessarily continue in that state for ever, were it to meet with no impelling force to set it in motion. And, therefore, at the time when the velocity begins, there must be a force applied to the moving body, when the state of the body will be changed. In the same manner, we know that when a force is applied, it is natural for the moving body to continue incessantly in that motion at which it first set out, until some resistance brings it to rest, by what is called the medium through which the body moves. Now, the same force being always applied at every succeeding advancement, the motion proceeds uniformly, according to the nature of the original impulse. Such is the nature and the efficient causes of uniform motion.

Uniformly accelerated motion again, is that in which the velocity increases in proportion to the time. The velocity is never the same in this case, but constantly varies in consequence of the action of gravity. Hence, it is evident, that the motion is produced by a constant succession of impulses, and without resistance. It is not, as in the former case, by one single blow, but by a variety of forces applied at different times. It is natural to think, that, since the weight of any body cannot be drawn from it by any rapidity of motion, the velocity must vary according to the time, otherwise the time would be thrown out of the account, whereas it is by means of *time*, as well as of *space*, that we measure motion in general.

We would not, however, be so apt to argue that the motion continues uniformly with the time. We can only learn this from minute observation and experiment. How, then, are we to ascertain and prove that the motion of gravity is uniformly accelerated? We must notice whether equal increments of velocity take place in equal time. Now, there are some difficulties here which are not easily overcome. How can we ascertain the degree of velocity, when that velocity is perpetually changing, in consequence of the varied impulses?

The only means which we can adopt, with satisfactory evidence, is to refer not to the velocity, but to the space passed over in a certain unit of time. Velocity, we have said, includes time and space. If no change takes place in the velocity, while the space is passed over, the space will be equal to the time. But when there is a change in the velocity, there is a difficulty in ascertaining the precise period at which we may calculate the time. In order to do this, it has been found and proved by experiment, that the space passed over will always bear a proportion to the time; and if we ascertain the space passed over in one unit of time, it is easy to calculate from the velocity which is required to cause that motion in that time, what will be the space passed over at another period of time, at the same or at a different rate; for the spaces are as the squares of the times.

Thus, time and space are the only means we have of ascertaining the velocity. The difficulty of ascertaining, in various degrees of velocity, the intermediate point from which we may calculate with accuracy and precision, is overcome in uniformly accelerated motion, by considering that in it the velocity at the be-

ginning and end of any time, must give us it by taking one-half the sum answering to the time, in the middle, between the beginning and end of the period. Therefore, in a second period of time, the space passed over will be triple of that passed over in the first.

D.

SCIENTIFIC EXPEDITION.

In the beginning of the summer 1817, M. Biot arrived in England, furnished with an apparatus for determining the length of the pendulum, the same, we believe nearly, that was used by Borda and Cassini. It was agreed that observations on the length of the pendulum should be made at London, at Edinburgh, and at the northern extremity of the greatest arc of the meridian that was to be determined by the trigonometrical survey of Britain, which, as was already known, must terminate in Shetland, between the small islands of Unst and Balta. M. Biot, accompanied by Colonel Mudge, his son Captain Mudge, and Dr. Olinthus Gregory, repaired to Edinburgh, and, having made observations at Leith Fort, embarked for Shetland. They were joined by Captain Colby, who conducted the trigonometrical survey, and who, with the zenith sector, was about to observe the highest latitude to which his system of triangles would extend. Colonel Mudge was forced, by bad health, to return; M. Biot and Dr. Gregory made their observations separately, but in the same small island; and the former continued till late in the season on the barren rock, where he was almost left alone, surrounded by a stormy sea, and a dusky and inclement sky. The spirits of a man accustomed to the finer climates of the south, must have sunk in such a situation, had they not been supported by his love of science, and his zeal for promoting its interests. He has written an account of his visit to Great Britain, and particularly of his reception in Scotland and the Isles, drawn up in an excellent spirit, full of good temper, cheerfulness, and a disposition to be pleased; and abounding also in judicious remarks. The Shetland Isles seem particularly to have interested him; and the contrast between the aspects which the moral and physical world presented in that remote region, to have struck him forcibly. He was pleased with the kindness, hospitality, and intelligence of his hosts; and they, no doubt, were filled with respect for an illustrious stranger, who, from the centre of civilization, had penetrated into their distant isle, and was connecting, with the researches and the renown of Science, the obscure and sequestrated corner in which Providence had fixed their habitation. He must have experienced feelings of high gratification, on considering that he had now assisted in defining both extremities of a line, extending from the most southerly of the Balearic to the most northerly of the Shetland Isles, the longest that the finger of Geometry had yet attempted to trace, or her rod to measure, on the surface of the earth;—a work that, in all ages, it will be the boast of the nineteenth century to have accomplished. The different aspects of nature, at the remote stations, which he had successively occupied, would not fail to present themselves with all the force that contrast can bestow;—the bright sun, the cloudless skies of the south, the glowing tints and the fine colouring of the Mediterranean, compared with the misty isle on which he now stood, and the tempestuous ocean which was raging at his feet. If he turned to the moral world, the contrast was also great, but it was reversed; and he would, perhaps, think of the fierce barbarians before whom he or his companions had been forced to fly, when the lonely islander was opening his cottage to receive him, and defend him from the storm. He would not then fail to reflect, how much more powerful moral causes are, than physical, in determining the good or evil of the human character.—*Playfair.*

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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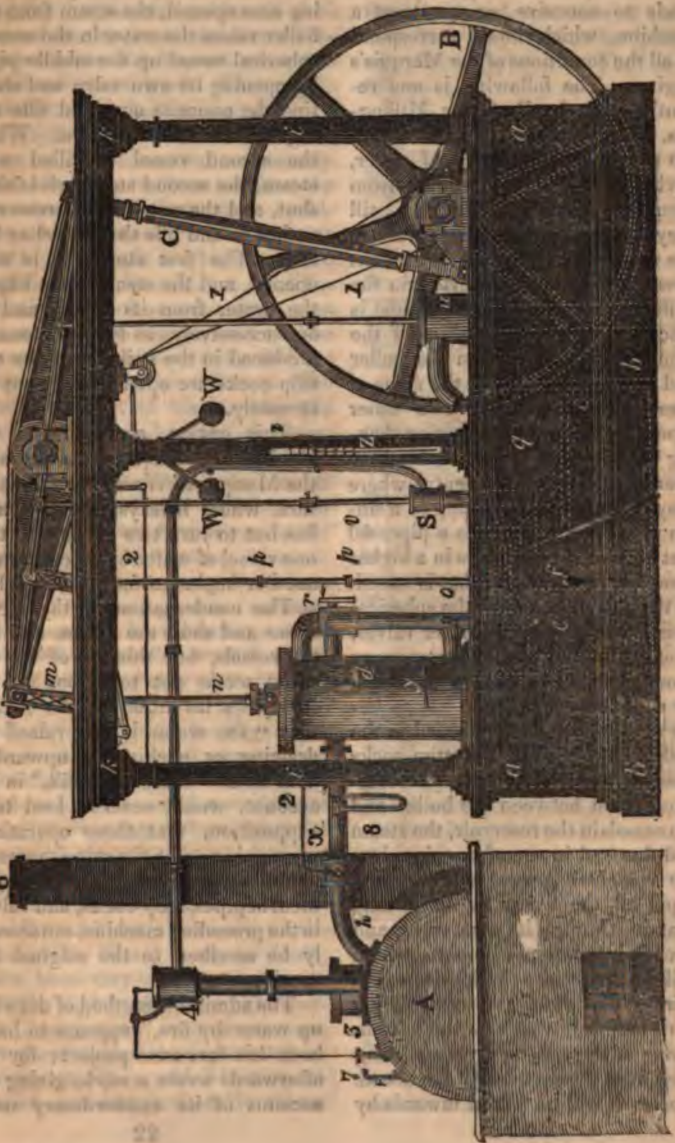
WATT'S TRUE MONUMENT, THE STEAM ENGINE.



HISTORICAL ACCOUNT OF THE ORIGIN AND CONSTRUCTION OF STEAM ENGINES.

(Continued from page 332, Vol. II.)

MARQUIS OF WORCESTER'S ENGINE.

An attempt has frequently been made to conceive, or construct a machine, which should correspond to all the conditions of the Marquis's engine. The following is one recently given by Professor Millington. Two hollow spherical vessels are placed in a reservoir of water, having two pipes proceeding from them, in a vertical direction, till they reach a boiler, situated above the reservoir; they are then bent down, and the ends inserted in the boiler; on the bend of each tube is placed a stop-cock to shut off the communication between the boiler and the vessels. From the sides of these vessels proceed two other pipes in a horizontal direction, having valves opening outwards, very near each other in the centre where they meet, and terminating in a single pipe; from this rises a pipe, 40 feet high, and terminates in a higher reservoir for the water that is raised. In the bottom nearly of the spherical vessels are placed two other valves, opening inwards, and other two very short pipes connected with them. A sufficient quantity of steam being supposed to be generated in the boiler, and one of the stop-cocks opened, so as to allow a free communication between the boiler and the vessels in the reservoir, the steam will descend in one of the pipes into the vessel connected with it, and expel all the water or air it may contain, through its own valve, and force it into the middle pipe, which will deliver it into the higher reservoir. The first stop-cock being shut, and the valve near the bottom of one of the spherical vessels being freed from the pressure of the elastic vapour, it will be forced inwards by the pressure of the water in the reservoir, which will speedily fill that vessel. The second stop-cock being now opened, the steam from the boiler raises the water in the second spherical vessel up the middle pipe, by opening its own valve and shutting the opposite one, and fills the higher reservoir as before. When the second vessel is filled with steam, the second stop-cock is then shut, and the water in the reservoir rushes in and fills that vessel as before. The first stop-cock is now opened, and the steam again expels the water from its vessel, and so on successively, as long as steam is produced in the boiler, and the two stop-cocks are opened and shut alternately.

This engine, according to the Professor, corresponds so far with the Marquis of Worcester's description, where he says, that "a man has but to turn two cocks, and that one vessel of water being consumed, another begins to force and refill."

The condensation of the steam opens and shuts the valves, and fills the vessels, but this use of the vacuum seems not to belong to the Marquis's invention, as he states, that "the water is not raised by drawing or sucking it upwards." The terms "force and refill," in his account, would seem to lead to a supposition, that these operations were going on at the same moment, in the same vessel. The arrangement of pipes, stop-cocks, and valves in the preceding machine, can scarcely be ascribed to the original inventor.

The admirable method of drawing up water by fire," appears to have been his favourite project; for he afterwards wrote a work, giving an account of its extraordinary uses

and powers, under the title of an "Exact and true Definition of the most stupendous water-commanding Engine, invented by the Right Honourable and deservedly to be praised and admired Edward Somerset, Lord Marquis of Worcester, and by his Lordship himself presented to his most excellent Majesty Charles the Second, our most gracious Sovereign." This work, instead of a definition, contains only an enumeration of the marvellous uses of his invention, as vaguely and obscurely written as those in the century of Inventions. Although one cannot but wonder at the boasting style in which he writes and bepraises himself, yet we differ from those authors who think that he was a mere boaster, and that he never performed any thing like the experiments he describes. The story, at least of his bursting the cannon by the elasticity of steam, can easily be put to the test of experiment by any one who doubts the truth of it. The tradition that his attention was first drawn to the amazing power of steam, from observing the lid of a vessel forced up a chimney, during some culinary operations in his chamber, when confined in the Tower of London, is not only probably the origin of his investigations, but agrees with ordinary experience; for, in general, it is in the solitude of some retired spot that the mind of man accomplishes its greatest discoveries; at least, this appears to have been the case with those of Newton and the Marquis of Worcester. The ideas which prevailed on the nature of the force of steam previous to the time of the latter, must, no doubt, have been very vague and obscure, and the engines that were constructed, must appear to be mere toys, compared with those capable of producing the effects which he contemplated, and which there is reason to believe he partly carried into execution. This opinion is very much strengthened by the last three articles in the "Century of Inventions," which appear to us, from the suggestion of a very ingenious friend, to hint more distinctly at the nature and operation of the atmospheric engine, than has perhaps ever been supposed. They are as follows:

98. An engine, so contrived, that working the *primum mobile* forward or backward, upward or downward, circularly or cornerwise, to and fro, straight, upright, or downright, yet the pretended operation continueth, and advanceth none of the motions abovementioned, hindering, much less stopping, the other; but unanimously and with harmony agreeing, they all augment and contribute strength unto the intended work and operation; and, therefore, I call this a *semi-omnipotent engine*, and do intend that a model thereof be buried with me.

96. How to make one pound weight to raise an hundred as high as one pound falleth, and yet the hundred pound descending, doth what nothing less than one hundred pound can effect.

100. Upon so potent a help as these two last-mentioned inventions, a water-work is, by many years experience and labour, so advantageously by me contrived, that a child's force bringeth up, an hundred foot high, an incredible quantity of water, even two foot diameter, *so naturally, that the work will not be heard even into the next room; and with so great ease and geometrical symmetry, that though it work day and night, from one end of the year to the other, it will not require forty shillings reparation to the whole engine, nor hinder one's day-work;** and I may boldly call it the most stupendous work in the whole world; not only, with little charge, to drain all sorts of mines, and furnish cities with water, though never so high seated, as well to keep them sweet, running through several streets, and so performing the work of scavengers, as well as furnishing the inhabitants with sufficient water for their private occasions; but likewise supplying rivers with sufficient to maintain and make them portable from town to town, and for the bettering of lands all the way it runs; with many more advantage-

* The words marked in Italics are said not to be in the original M.S.

ous and yet greater effects of profit admirable and consequence. So that deservedly I deem this invention to crown my labours, to reward my expenses, and make my thoughts acquiesce in way of further inventions; this making up the whole century, and preventing any further trouble to the reader for the present, meaning to leave to posterity a book, wherein, under each of these heads, the means to put in execution, and visible trial, all and every of these inventions, with the shape and form of all things belonging to them, shall be printed by brass plates.

Our friend suggests, that the *primum mobile* spoken of by the inventor, in the 98th article, is no other than the atmosphere itself, which certainly rendered the engine very powerful, though it fell short of being *semi-omnipotent*. And, as to the idea of a *model* being buried with him, it is only an ingenious and poetical mode of expressing the fact, that common air must be shut up in his tomb along with him. The 99th article expresses, in most exact terms, the operation of the engine, by means of the piston and vacuum formed under it, and the motion of the lever or beam. The 100th article explains, in a manner truly prophetic and wonderful, the effects produced by this engine, of which the chief object appears to have been the raising of water, and it is well known that draining mines and coal-pits, was their principal use for more than a century. The description of its utility in introducing water into cities, as we have it in Glasgow at this day, is admirable, and shows, that the author was worthy of greater esteem than we have reason to believe he enjoyed from his cotemporaries. Indeed, what can be more true, and, at the same time, more beautiful, than his idea of rendering "rivers portable from town to town." Have we not seen it verified? Are not some canals in England wholly supplied from rivers by means of the steam engine? If Brindley was admired for his answer, when, upon being asked what he thought rivers were made for, he replied, "To feed canals," shall we not admire Worcester for a more beautiful idea, and give him equal credit for the conception of its practicability? That he did not carry all his ideas into execution, does not seem to have been so much his fault as that of the age in which he lived. But it has often happened that an individual has not only suggested an idea, but made several valuable steps towards its completion, when the ignorance, or the folly, or the want of public spirit in his cotemporaries has prevented its accomplishment, and left the glory of the invention to others.

MORELAND'S ENGINE.

In the year 1683, Sir Samuel Moreland exhibited an apparatus for raising water by steam before the King of France, at St. Germains, but he appears to have been unsuccessful in his application to that Court for encouragement in his invention. No description of his apparatus, or the mode of its action, is known to exist. The results of some experiments, however, made by Sir Samuel upon the elasticity of steam, are still preserved among the manuscripts in the British Museum. His account of these experiments is in French, written on vellum, in a very beautiful hand, and highly ornamented. The volume, on the title page, is said to have been presented to the King of France by Sir Samuel Moreland, *Master of Mechanics* to the King of England. It is rather a remarkable performance for the period at which it was written, as the following extract will show: "Water being evaporated," says he, "by the force of fire, its vapour occupies a much larger space, (about two thousand times,) than it occu-

pied before. And its power is so prodigious, as, if it were closely confined, to burst a cannon; but, being governed upon statical principles, and by science reduced to measure, weight, and balance, it then bears itself quietly under the harness, (like good horses,) and becomes of great use to mankind, particularly for the raising of water, according to the following Table, which shows the number of pounds (French) weight which may be raised to the height of six inches eighteen hundred times a minute, in cylinders about half filled with water, as well as the different diameters and depth of the cylinders.

CYLINDERS.

Diameter.	*Length.*	*Weight to be raised.*
1 foot ...	2 feet	15 lbs.
2 feet ...	4	120 ...
3	6	405 ...
4	8	960 ...
5	10	1875 ...
6	12	3240 ...

In the following columns, the first denotes the number of cylinders, having each a diameter of six feet and a length of twelve feet, which are required to raise the number of pounds weight of water contained in the second column:

Cylinders.	*Water.*
1	3240
2	6480
3	9720
4	12960
5	16200
6	19440
7	22680
8	25920
9	29160
10	32400
20	64800
30	97200
40	129600
50	162000
60	194400
70	226000
80	259000
90	291610

It is remarkable that these results of the experiments by Sir Samuel, which must have been made with considerable care, agree more nearly with those of the present day than could have been expected; and that his estimate of the rate of expansion of water, when converted into steam, coincides with that of the most recent work on the subject. He says, in the above passage, that steam is "about 2000 times" the volume of the water which produced it; Desaguliers, Ferguson, and many others, stated it at 14,000 times! Professor Robison gave the result of Mr. Watt's experiment as between 1800 and 1900 times only. Sir Samuel's method also of stating the quantity of water which may be raised to a certain height a given number of times in a minute, is still followed by modern engineers; he is, on these accounts, entitled to the merit of being considered as the first accurate experimenter on the elastic force of steam.

PAPIN'S ENGINE.

The next inventor in the history of the steam engine was Dr. Papin, a Frenchman. His first project was to procure a first power by means of an air pump, to transmit to considerable distances the action of a mill through the medium of pipes. The cylinders of air pumps, at one extremity, were made to communicate by pipes, with equal cylinders placed at the other and distant end, which, by some intermediate mechanism, were there connected to the piston-rods of the pumps of a mine. When the mill was put in motion by a fall of water or otherwise, the pistons of the cylinders to which it was attached were elevated or depressed, as it might be, and the pistons at the other distant extremity of the pipe had an opposite motion up or down. When the pistons attached to the mill were elevated, the others were

depressed, and so on in succession. This project failed even as an experiment, from the very great resistance of the piston, even when one cylinder was attached to the other by a pipe only a few inches in length, and the slowness with which the motion was communicated. The inventor attempted to obviate this, by making a vacuum under the cylinder in some other way than that of pumping out the air by the mill. In 1688 he proposed an improvement, which consisted in displacing the air in the cylinder under the piston by exploding gunpowder; the power, however, was found to be trifling; for, without endangering his apparatus, he never could make the gaseous product in the under part of the cylinder so entirely to fill its capacity as to have no air under the piston. Dr. Hooke and others, who had heard of both of Papin's projects, showed him that however perfect the exhaustion might be in each, if the pipe of communication were of any length, the compressibility of the air, independent of friction, was so great, that unless his cylinder or stroke of the piston was enormously long, the motion of the piston at the other end would be imperceptible. In 1690, he published a description of this mode of using gunpowder, and the idea of transmitting motion to a great distance was fulfilled by his forming a vacuum not only under the piston, but in the pipe of communication. This plan, though ingenious, was however nearly impracticable, from the great difficulty of abstracting the air by the air pump or gunpowder; to obviate this, he proposed to employ steam to form the vacuum under the piston, and also to raise the piston by its elasticity. In these investigations, he shows *that a little* water, changed into *steam, produces* an elastic power like air; but that it totally disappears when chilled and changes into water; by this means he saw that a machine could be so contrived, as, with a small fire at a trifling expense, to produce a perfect vacuum. In developing another scheme, "Where there may not be the conveniency of a near river to ply the aforesaid engine," (1685,) he proposes alternately "turning a small surface of water into vapour by fire applied to the bottom of the cylinder that contains it; which vapour forces up the plug (or piston) in the cylinder to a considerable height, and which, as the vapour condenses, (as the water cools when taken from the fire,) descends again by air's pressure, and is applied to raise water out of the mine." Had this happy idea been submitted to experiment, there is no doubt but he would have produced the Atmospheric Engine. Yet, although the merit of a first idea is due to this ingenious mechanician, the merit of putting it into practice is due to another.

SAVERY'S ENGINE.

Soon after this, from the inadequacy of the ordinary means to drain mines, among many others, the attention of Mr. Savery, a sea captain, was directed to the invention of some machinery to diminish the labour and expense attending such operations. Having invented an engine for this purpose, he exhibited a model of it before King William, at Hampton Court; and the success of the experiment appeared so satisfactory, that the King became warmly interested in the plan. In 1699, he obtained a patent, erected some engines, and made a trial of one before the Royal Society. His engine consisted of two boilers, such as are used for brewing, connected together at the top by a pipe, and fixed in a good

double furnace, and so contrived that the flame of the fire may circulate around them. The two boilers had two small gauge pipes and cocks at the top, by which they were filled with water; the great boiler was, however, filled only two-thirds, and the small one quite full. The great boiler was furnished with a regulator and handle at the top, by which the steam was confined or allowed to escape at pleasure. Alongside of the great boiler, and connected with it by means of pipes issuing from the top, were placed two pretty large vessels of an oval form, for the condensation of the steam; from the bottom of each issued two branch pipes, connecting them with a vertical pipe, in which the water rose, when the vacuum was formed. This pipe was double to a certain extent, both above and below the branch pipes, each branch of this double part being furnished with a clack above and below the points, where they are united into one, to indicate the admission of the steam or air and water. When the great boiler was heated, the steam was made to issue with an irresistible force from the top, by pushing the handle of the regulator as far as it would go; by this means one of the vessels was filled with steam, which operation was indicated by the noise of the clack in the upper part of the branch of the vertical pipe connected with it. The regulator was then brought back, and the steam being prevented from entering the first vessel, which was now full of it, was made to fill the second vessel in like manner, until it had discharged its air through the clack, up the force or vertical pipe. In the meantime, by the condensation of the steam in the first vessel, a vacuum was created, so that the water necessarily rose up through the sucking or vertical pipe, lifting up the clack, and filling that vessel. The second, in its turn, being emptied of the air, the regulator was pushed back, and the force was exerted upon the surface of the water, which being only heated by steam, did not condense it, but caused it to press with the elasticity of air, and still increase in its elasticity, till it counterpoised or exceeded the weight of water ascending in the forcing pipe; the water in this pipe was immediately discharged, when once it reached the top, which took some time to recover that power; this being once obtained, however, and the engine working, it was easy for any one that never saw it before, after half an hour's experience, to keep a constant stream running out to the full bore of the pipe. On the outside of the vessel might be seen how the water went out, as well as if it had been transparent; for as far as the steam existed in the vessel, so far was it dry without, and so hot as to be scarcely touchable by the hand. But as the water extended, the same vessel was cold and wet, where any water had fallen on it; this cold and moisture vanished as fast as the steam, in its descent, took place of the water. If all the water were forced out by the steam, when the latter began to pass through, it rattled the clack so as to give sufficient notice to pull the regulator; this forced out the water from the second vessel without the least alteration in the stream; the steam was prevented from going off, (which would have been a loss of power,) by pulling the regulator before the forcing vessel was quite emptied. A small cistern was placed above the great boiler, by turning the cock of which upon one of the vessels, the water proceeding from it, caused, by its coolness, the steam to condense, so that the first vessel was completely filled while the second was emptying. In the

same manner was the steam in the second vessel condensed, so that it filled while the first was emptying. "The labour of turning these two parts of the engine," says the inventor, "namely, the regulator and water-cock, and tending the fire, being no more than what a boy's strength can perform for a day together, and is as easily learned as their driving of a horse in a tub-gin; yet, after all, I would have men, and those, too, the most apprehensive, employed in working the engine, supposing them more careful than boys." To replenish the great boiler with water, which required about two hours, the cock of the small boiler was turned, which cut off all communication between it and the force-pipe, with which it was connected, for the purpose of supplying it with water. By this means, the small boiler became hot from the fire below it, and very soon gained that strength which the great boiler had lost by sending forth its steam. The water in the small boiler being then depressed by its own steam, rose through the connecting-pipe, between the two boilers, and continued running into the great boiler, till the surface of the water was below the surface of the connecting-pipe, in the small boiler. The noise of the clack in this pipe indicated when the water in the small boiler was reduced to within eight inches from the bottom, and it was then refilled as before: thus a constant motion was produced, "without fear of danger, of disorder, or decay." To ascertain if the great boiler was more than half exhausted, the small cock was turned, when if the water was above the level of the bottom of the pipe attached to it, which was half way down the boiler, it delivered water, but if not, *it delivered steam*. So likewise it *showed if more or* less than eight inches of water were in the small boiler, "by which means, nothing but a stupid and wilful neglect or mischievous design, carried on for some hours, could any way hurt the engine. In short, the engine was so naturally adapted to perform what was required, that even those of the most ordinary and meanest capacity might work it for some years without its receiving any injury, if not hired or employed by some base person to destroy it."

This engine, which was thus described in his book entitled the "Miner's Friend," was applied by Savery to the raising of water to palaces, gentlemen's seats, draining fens, and supplying houses with water in general, and pumping water from ships; and he erected many of them in England. The power of his engine he limited only by the strength of the pipes and vessels; for, says he, "I will raise you water 500 or 1000 feet high, could you find us a way to procure strength enough for such an immense weight as a pillar of water that height; but my engine at 60, 70, or 80 feet, raises a full bore of water with much ease." And comparing this performance of his machine with that by manual labour, he continues, "I have known, in Cornwall, a work with three lifts, of about 18 foot each, lift and carry a 3½ inch bore, that cost 42*s*. a-day (reckoning 24 a-day) for labour, besides the wear and tear of engines, each pump having four men working eight hours, at 14*d*. a man, and the men obliged to rest at least a third part of that time. I dare undertake that the engine shall raise you as much water for 8*d*. as will cost you 1*s*. to raise the like with your old engines in coal-pits, which is £33 6*s*. 8d. saved out of every hundred pounds; a brave estate gained in one year out of such great works! where 3, 6, or it may

be £8000 per annum is expended for clearing their mines of water only, besides the charge and repair of engines, gins, horses, &c."

Except stating that an engine raising a column of water 60 feet high and $3\frac{1}{2}$ inches in diameter, requires a fire-place 20 inches deep, Savery gives us no information of the proportions of his engines in the Miner's Friend.

Some standard of reference was necessary to give definite information of the effect of this new engine; and Savery introduced the term *horse's power;* which is still in very general use. A certain number of horses were kept to raise a certain quantity of water to a certain height; so a steam engine, on Savery's construction, was called a one, or a two, or a three-horse engine, as it raised the water which had hitherto been raised by one, or two, or three horses.

[*To be concluded in our next, when the description of* MR. WATT'S *Engine will be given.*]

GALVANIC ENGINE FOR PROPELLING VESSELS.

SIR,—In communicating my plan of a Galvanic Engine, No. XLIII. I stated, as a reason for not delaying it, the possibility that I might otherwise be superseded, because, in that case, it would have fallen to the ground; and this, I believe, would be the feeling of every mind of common honesty and candour. But, behold, the event has taken place as I anticipated. Several weeks after the publication of my plan, it is boldly announced in the Chemist as a new invention, and an invention of some other person, no doubt, though I have not been able to procure the Number of that work which contains the article, otherwise I should have noticed it sooner. In announcing my plan, I said, that I had thought of it for SEVERAL YEARS; this is a truth; but I lay no stress on that, as it is only my own assertion; neither need the author of the article in the Chemist expect credit, if he rests his claim on such a foundation. The only fact which can substantiate a right of that nature is priority of publication. My description was written and transmitted to you on the 15th, and published on the 23d October; and it is mentioned in the Glasgow Chronicle of the 30th October; but mark, the discovery in the Chemist *is noticed in the Glasgow* Chronicle of the 23d November, and I believe it was published on the Saturday preceding, viz. the 20th November. You will see by this, that the Galvanic Engine was invented OVER AGAIN, about a month after the description of mine was published. In all attempts that have been made to appropriate the inventions of others, circumstances have generally favoured the imposition; but to pretend to discover what has been published to the world several weeks before, is really foolish. I hope, Mr. Editor, you will, with your usual spirit, defend the character of your own publication, and the rights of your Correspondents.

I am, Sir, your's, respectfully,

G. M.

Glasgow, 9th December, 1824.

Our Correspondent really brings a serious charge against the Chemist or its Correspondent, if such be the case; and, indeed, we have reason to believe there is some truth in it, as we have heard it from various quarters, although we ourselves have likewise not been able to procure a copy of the Number of that work which contains the article in question. We shall certainly, if we find our Correspondent in the right, as soon as a copy comes to hand, assert both his and our right to the honour of the invention.

ON THE FOUR PRIMARY LAWS OF LIGHT.

Of the various theories that have been given of the mechanism of light, there are two, *viz.*, those of Descartes and Newton, which particularly deserve to be mentioned. The sensation we feel in regard to the change effected on the appearances of bodies by light, is like all such primary sensations, simple, and therefore unanalyseable. Light, therefore, is an object of nature of which we can have no idea, of whose presence and effects we must be entirely ignorant, without the sense of vision. Without this precious instrument we know, indeed, that its mechanism may, and in one instance, has been apprehended;* but yet it is evident that the celebrated individual to whom I refer, could have no idea of the real force of the experiments and phenomena on which the theory he so ably taught and inculcated, did ultimately rest. To all, however, who are endowed with the sense of sight in any degree of perfection, the difference in the sensations produced by light and darkness, as also the varieties arising from their several degrees of intensity, are sufficiently familiar. Now the first step from mere observation of these effects, towards a knowledge of the nature of the productive cause, is, that there must be a fluid acting at once on the objects perceived, and the sense perceiving them. This seems to be the first conclusion to which the investigator of the laws of nature comes, on perceiving the effects of this curious part of her workmanship—it is, therefore, an idea that is acknowledged equally by both of the theories in question. Both of these suppose the existence of a fluid, and they only differ in regard to the manner of its operation. According to Descartes, this fluid is a subtile matter, widely diffused throughout space, by undulations or vibratory motions, in which produced by the approach of luminous bodies, light is propagated. According to Newton, on the other hand, light arises from an actual emersion or emanation of particles from luminous bodies, projected from them on all sides, and proceeding with an almost incalculable velocity. According to the one theory it is propagated in a similar way, with sound, except in so far as the fineness of the medium varies the case; according to the other, it is produced in the same way, by luminous bodies, as effluvia are thrown off by odoriferous ones, except in so far as the particles of which it is composed, bear no proportion in size to the corpuscles, however minute, that affect our sense of smell. The one theory, indeed, seems to appeal, in some measure, for illustration to this sense; the other has a direct reference to the constitution of the objects of the sense of hearing. According to Descartes, in one word, a ray of light consists in a line or succession of moleculæ having communicated to it, and repeated in it, in the manner already mentioned, a slight or oscillatory or vibratory motion; as conceived of by Newton, it is equally a continued and uninterrupted series of moleculæ; but these, however, have each an impulsive force of their own, and proceed on in rapid succession.

Neither of these hypotheses pretend to give us any insight into the absolute nature, if we may so speak, of the substances in question; they only try to account for the phenomena it exhibits, on the acknowledged laws of matter and motion; and it is obvious that in proportion to the comparative ease and consistency with which they do so, must

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* *I allude to Dr. Sanderson's far-famed case.*

they either stand or fall. Without, therefore, entering very largely into their merits, it may not be very difficult to apply this test in at least one or two instances. As however in doing so, it would be necessary to refer to those facts concerning light—those laws which it seems universally to obey, it will be proper, in the first place, to give a statement of them. After having taken a short survey of these laws of light, which indeed are incontrovertible facts, derived from observation and experiment, and dependent on no theory whatever, we shall be the better qualified to decide on the merits of the theories that pretend to account for them.

I. The first of these general facts is, that light is propagated in straight lines, and this is proved by a great variety of simple, yet convincing experiments. To a person, placed for instance in a dark room, in the shutter of whose window an aperture has been made for the admission of some of the sun's rays, this fact is exceedingly obvious. Suppose him accommodated with a small lid, by which he can close up the passage, and immediately all is darkness within, whilst on opening it, to all sense, instantaneously a beam of light rushes upon the opposite wall, and continues to illuminate a *straight* line of atmosphere between the window and the part on that opposite surface on which it falls. Now, since this is invariably the case, and must have been frequently remarked by all, it seems necessarily to follow, that light is propagated in straight lines; a fact, indeed, on which the whole theory of perspective depends for its truth, and which at once may be accounted the most obvious and most important, perhaps, with which the optical enquirer has to do. A very convincing proof of its truth might farther be derived from considerations with regard to the shadows of objects; but as these are of a nature rather more extensive, as well as more intricate, I shall not at present attempt to exhibit them.

II. It may, therefore, on the whole, be fairly assumed as a principle, that light in its passage through space, holds a rectilineal direction. From this course, however, it is equally true, that it is capable of being made to deviate by the interrupting surfaces of opposing bodies. It is, therefore, stated as a second law, that when a ray of light meets a polished surface, when it tends from one medium to another, which does not admit it, and is therefore forced back into that which it has already traversed, it is said to be reflected, and that in this case the angle of reflection is equal to the angle of incidence. A ray of light falling on such reflecting surface is called the incident ray, and the angle which the line of its direction makes with a perpendicular to the reflecting surface passing through it at the point at which the incident ray strikes it, is called the angle of incidence. Whilst the angle made with the same perpendicular, by the new direction of the ray, as it leaves the reflecting surface, is called in like manner, the angle of reflection. Now it is affirmed that these two angles are invariably equal, and that two parallel incident rays are in like manner, invariably parallel when reflected,* a fact, which, like the last, is proved by the most convincing experiments, and in this way alone.

III. When the medium which interrupts its rectilineal progress (it may be stated as a third principle,) is of such a nature as to admit it, light undergoes another kind of

* This is with the provision that the reflector is a plain surface.

deviation; it is bent in its course at the contiguous surface, and is said to be refracted. Immediately on approaching the point of immersion (the point at which it enters the new medium,) the ray is turned into a new direction, and at the point of *emergence*, (that at which it comes out,) it seems as it were broken and dissipated. Hence the name it receives of broken or refracted ray. Here, as before, the angle of incidence, is that which is made by the incident ray, with a perpendicular drawn through the point of immersion, and that is called the angle of refraction, which the broken ray makes with the same perpendicular. Now, between these two angles, it is farther to be remarked, there is a constant proportion. This varies with the medium employed, and so also does the direction of the refracted ray. Observation proves that if light passes from a rare, into a denser medium, the refracted ray approaches the perpendicular at the point of immersion; if from a dense into a rarer medium, it recedes from it. It also assures us, that if it passes from air into water, the sine of incidence will be to that of refraction, as 4 to 3; if from air into glass, as from 3 to 2. This truth making the third law of light, was first discovered by Snell, so early as the beginning of the 17th century, and was afterwards put beyond all doubt, by the observations of Descartes.

IV. In the last place, it may be stated as an ultimate fact with regard to this substance, that it consists of rays possessing different degrees of refrangibility. For the ascertainment of this, we are wholly indebted to the labours of Sir Isaac Newton, whose sagacity in the management of experiments is only equalled by the wonderful stretch of intellect displayed in his *reasonings upon* them. To give even a brief sketch of his numerous experiments on this subject, would far exceed our utmost limits. These experiments were of three different kinds, and were varied by him in a great number of ways. Let this short statement of one of the easiest processes, by which the conclusion may be come at, suffice. We have already seen, for it results from the first mentioned fact, that if a beam of the sun's light be received into a darkened room, by an aperture in the window shutters, a lively and nearly circular image will be formed on the opposite substance within on which it falls. Suppose this the wall or a screen, and between it and the aperture, let be placed any transparent substance, whose sides are not parallel, a triangular prism, for instance, and the image will then be characterized by the following circumstances. According to the position of the prism the image will fall either higher or lower, and incline to the right hand or the left of its former place on the wall. Instead of being circular, as before, it will now be oblong, rounded at the ends, and terminated on the sides by straight lines. But what is more to the present point, the image itself is no longer, while it exhibits a variety of colours, each shading into one another, and thus resembles the appearance of the rainbow. Now, by this fact, the first part of the proposition is proved, namely, that light is made up of a variety of homogeneous rays, which are blended together in the beam we have supposed admitted by the aperture in the window; and which, however, by means of the prism, are shown quite distinctly on the spectrum it forms on the wall. These rays are 7 in number, and excite in our organ of light, the sensations of violet, indigo, blue, green, orange, yellow, and red. But they are of different degrees of refrangibility, and

this Newton found by marking the relative proportions of the angles of incidence and refraction, with regard to each of them separately. These relations may be shortly given in the following notation:

1.54			
1.5425	... 25	... R.	... 45
1.544	... 15	... O.	... 27
1.5466	... 26.6	... Y.	... 48
1.55	... 33.3	... G.	... 60
1.553	... 33.3	... B.	... 60
1.555′	... 22.2′	... I.	... 40
1.556	... 44.4	... V.	... 80
			360

Such then are the four great general facts respecting the propagation of light. We ought now to consider how they are accounted for. As I have already extended this paper too far, I shall defer my remarks on the comparative merits of the two theories formerly stated, till a future opportunity. Both of these theories, it must be acknowledged, have been supported with great plausibility, and considerable success; but there is no impartial observer who will pretend to deny that the objections which have been brought against both, are far from being unworthy of consideration.

M.

VERY USEFUL MATCHES.

Mr. Editor,—It is but lately that I have become a reader of your Magazine, and am only sorry that I was not one from its commencement, as I have so long denied myself much enjoyment.

Should the present communication be acceptable, I will occasionally contribute my mite to the support of your Magazine, by sending you any little receipt which may occur to me to be useful, whether original or select. I therefore send you the following, which, I think, may be useful to many of your readers, for though it is but a common one, yet a number of them may be unacquainted with it.

Easy method of procuring a light when there is not a fire at hand.

Matches kindling without fire, may be procured, by mixing two parts of the oxymuriate of potash, and one of sulphur, which, by means of a little gum, is attached to a common sulphur match. This match, on being dipped into, or slightly wet with strong sulphuric acid, (vitriol,) immediately catches fire. The potash must be pulverized before it is mixed with the sulphur, as, when they are rubbed together in a mortar, unless the quantity be very minute, they will explode with considerable force. A neat little box of matches, prepared in this way, may be procured at Mr. Liddell's shop, Argyle-Street. It is of French manufacture, and costs only 6d.

ı. ∂.

West St. Vincent-Street,
Glasgow, 9th December, 1824.

ON THE DIVISIBILITY OF MATTER.

There appears to be only two elementary principles in nature, to which all the varied and innumerable phenomena which come under the cognizance of our bodily and mental powers, can be referred. To investigate the nature and origin, the properties and qualities of these two principles, which are termed Mind and Matter, has occupied the attention of philosophers in all ages. Matter, as being more palpable to the senses, has been most successfully explored, and has afforded the greatest scope for the restless ingenuity of man, although in reality after all his researches into the arcana of nature, we are still as ignorant of its real nature or essence as that of Mind.

The view of that portion of the

Deity's works, which is the direct object of our senses, is very limited and defective; but by the sublime discoveries of science and art, it is so widely extended that we are lost in infinity on either side of our actual perception.—The immensity of objects in number and magnitude on the one hand, and their extreme minuteness and imperceptibility on the other, are so stretched beyond the reach of our faculties, that the greater part of nature's operations are entirely concealed from our view. As all magnitude taken abstractly, can be enlarged or diminished to infinity, so in nature, the extreme limits between the largest and the smallest objects in the external creation, are in reality placed at an inconceivable distance from each other. As little can the natural or intellectual eye stretch its visual ray to the boundary of that vast expanse, over which nature extends her sway, or fix the termination of the universe; as it can trace the elements of things, or discover those limits which terminate the particles of matter.

The greatest mountains are but a speck, compared with the volume of the earth; our mighty globe is but as the "small dust of the balance," among the orbs of the solar system. On some of them it is only noticed as a distant star in the vault of heaven. In other parts of the universe it is entirely unknown, or visible only at certain intervals, and that when assisted perhaps by the telescope of some immortal Newton. The sun itself, the object of our greatest admiration among the works of nature, is reduced to the insignificancy of a star, and the vast orbits of Saturn, and of those flaming comets that float in the regions of immensity, all crowd into a point when viewed from some of those distant parts of creation. The light of other suns illuminate other systems where the beams of our sun are unfelt and unperceived; and these in their turn are diminished and unknown in the unlimited range of space.

If we reduce our view of nature to a narrower focus, and approach the other limit of existence, we find a similar progression from the minutest objects of sense to minuter still, and are conducted as far below the phenomena of perception, as in the former case above them, by a series of gradations, that, in like manner, are enveloped in the folds of obscurity. There is no reason to suppose that the subdivisions of matter have any termination, and that its elementary particles are so impenetrable and incomposed as to be incapable of any farther separation into parts. From the astonishing powers of the microscope, animals are discovered, myriads of which can scarcely form a particle perceivable by our unaided sense, each of which have vessels peculiar to them, and fluids in these vessels in a state of constant circulation; from the conceptions we must necessarily form of the propagation, nourishment, growth, and bodily parts of these animalculæ; from the multifarious and astonishing experiments of chemistry; and in particular from the inconceivable diminutiveness of the particles of light which find their way, equally and in all directions, through the pores of transparent bodies; it is evident that the divisibility of the particles of matter descends by infinite degrees, that our imagination is stretched to the utmost, and that nature is inexhaustible on every side.

Matter is generally considered as consisting of ultimate particles or atoms incapable of divisibility. But it appears to me impossible for the mind to conceive of any limit to the division of a body, however small it may be; at least as long as we attribute to that body, or to its parts, those qualities which are commonly ascribed to all material substances. There are certain qualities called primary, without which we cannot conceive matter to exist. The first of these, and the most essential, if not the only primary quality, is denominated *extension*. For if we abstract all other qualities from a body, or conceive them to be abstracted, such as heat, cold, hardness, softness, colour, &c. this alone will remain; that is, we cannot conceive of a body in existence, without having some determinate form, figure, shape, size, bulk, or magnitude; and hence it is so difficult for us to form a notion of spirit or mind; because we are always apt to attribute some form or shape, or at least some extension or occupation of space to this essence of immateriality. The vulgar undoubtedly form such notions of ghosts, apparitions, hobgoblins, &c. for they generally represent them as endowed with some particular shapes, and imagine them to be so far corporeal as to be able to perform the actions of an earthly being, to remove some enormous piece of furniture out of its place, or to

knock down their opponents by a single blow. It is even difficult, I imagine, for the most philosophic mind, to conceive of a spirit abstracted from the body without attaching to it some idea of form, or at least, the occupation of space. Suppose a person most firmly convinced of the immateriality of the soul, to be confined all night in one of the depositaries of the dead, it might be doubted whether his philosophy would entirely preserve him from every kind of fear or apprehension.

By this digression, it is not meant to deny the immateriality of the thinking principle, but merely to show how difficult it is conceive of its existence abstracted from material qualities. It is evident, however, that matter must occupy space, and, consequently, must be extended; our idea of space even arises from this circumstance; and it has been questioned, (though I think unnecessarily,) whether we can have any notion of space distinct from matter.—Every *body*, therefore, however small, must have some particular form or figure. If we, then, consider the particles of matter as bodies, (and how can we conceive of them otherwise,) whether in a separate or combined state, it appears to me that we must also conceive them to be capable of continued subdivision. No material object that meets our senses exists without this capability, and how can we suppose that particles of matter, though beyond their reach, should not possess the same?

Dr. Reid on this subject says, "that in the division of a body, although the parts become too small to be perceived by our senses, we cannot believe that it becomes incapable of being farther divided, or that such division should make it *not* to be a body. We carry on the division and subdivision in our thought far beyond the reach of our senses and we can find no end to it. Nay, I think," says he, "we can plainly discern that there *can* be no limit beyond which the division cannot be carried." We shall perhaps, perceive this better by an example.

Suppose any material substance be taken of an inch diameter; it is evident we can divide this substance into two, three, four, five, &c. parts, a great way. Now suppose this body to be divided into a million or a billion of parts, these parts must be something, that is, they must have some magnitude, though perhaps not perceivable by the senses. We can still farther conceive of one of these very diminutive parts as divisible into as many parts of the first body, and still we must conceive of them as existing in some shape or other; and so on our conception carries as to infinity in this process or division without end; for if these particles should come to an end, we must conceive them to be nothing at all, and, consequently, that matter would be annihilated by division; but we conceive that matter cannot be annihilated, except by supreme power, and, consequently, if matter retains its existence, that same power could divide it *ad infinitum*. Dr. Reid says farther on this subject, "that if there be any limit to this division, one of two things must necessarily happen. Either we have come by division to a body which is extended, but has no parts and is absolutely indivisible, or this body is divisible, but as soon as it is divided it becomes no body. Both these positions seem to be absurd, and one or the other is the necessary consequence of supposing a limit to the divisibility of matter." Locke has expressed a similar opinion on this point, in the following words: "And since in any bulk of matter our thoughts can never arrive at the utmost divisibility, therefore, there is an apparent infinity to us also in that, which has the infinity also of number, but with this difference, that in the former considerations of the infinity of space and duration, we only use addition of numbers; whereas, this is like the division of a unit into its fractions, wherein the mind also can proceed *in infinitum*, as well as in the former additions, it being indeed but the addition still of new numbers."

(To be continued.)

UTILITY OF THE MATHEMATICS.

Dr. Barrow speaks of the Mathematics as that "which effectually exercises, not vainly deludes, nor vexatiously torments studious minds with obscure subtleties, perplexed difficulties, or contentious disquisitions; which overcomes, without opposition, triumphs without pomp, compels without force, and rules absolutely without causing the loss of liberty: which does not privately over-reach a weak faith, but openly

assaults an armed reason, obtains a total victory, and puts on inevitable chains; which plainly demonstrates and readily performs all things within its verge." "The Mathematics, which depends upon principles clear to the mind, and agreeable to experience, and draws irresistible conclusions; which is the fruitful parent of, I had almost said, all arts, the foundation of sciences, and the plentiful fountain of advantage to human affairs. In which last respect we may be said to receive from the Mathematics the principal delights, securities, and conveniences of life. To this it is principally owing, as a theoretic spring of action and benefit, that we dwell elegantly and commodiously, build convenient houses for ourselves, erect stately temples to God, and leave wonderful monuments to posterity." "That we have safe traffic through the deceitful billows, pass in a direct road through the trackless ways of the sea, and arrive at the designed ports by the uncertain impulse of the winds; that we rightly cast up our accounts, dispose, tabulate, and calculate scattered ranks of numbers, and easily compute them, though expressive of heaps of sand, or mountains of atoms; that we make pacific separations of the bounds of lands, examine the moments of weights in unequal balance, and distribute every one his own by a just measure; that with a light touch we thrust forward ponderous bodies which way we will, and stop a huge resistance with a very small force; that we accurately delineate the face of this terraqueous globe; and, by diagrams, subject the economy of the universe to our sight; that we aptly digest the flowing series of time, distinguish what occurs by appropriate intervals, rightly predict and discern the various returns of the seasons, the stated periods of years and months, the alternate increments of days and nights, the doubtful limits of light and shadow, and the exact differences of hours and minutes; that we derive the subtile virtue of the solar rays to our uses, infinitely extend the sphere of sight, enlarge the near appearance of things, bring to hand things remote, discover things hidden, search nature out of her concealments, and unfold her mysteries; freely range through the celestial fields, measure the magnitudes and determine the intervals of the stars, trace the inviolable laws of their motions, and ascertain the limits within which the wandering circuits of the heavenly bodies are confined."

SOLUTION OF THE WINE QUERY.

(See page 275, Vol. II.)

THE cask holds 600 bottles; now, a bottle taken out at a time, is the $\frac{1}{600}$ part of the whole, which leaves $\frac{599}{600}$ parts behind; and this $\frac{599}{600}$ is a constant multiplier for 90 times; therefore, 600 multiplied by $\left(\frac{599}{600}\right)^{90}$ *must give* the bottles of pure wine remaining; thus $600 \times \left(\frac{599}{600}\right)^{90} = \frac{599^{90}}{600^{89}}$;

Hence log. of 599, or $2.7774268 \times 90 = 249.9684120$
And log. of 600, or $2.7781513 \times 89 = 247.2554657$

log. of $516.35 = 2.7129463$

Hence 516.35 bottles remained in the cask, and 83.65 were stolen by the butler.

RUSTICUS.

NOTICES TO CORRESPONDENTS.

Rusticus would oblige us by transmitting the manuscript on the solution of equations that he mentioned.—J. S., on the Properties of Milk and the Lactometer, in our next.—P. R., A Country Dominie, W. C., M. N., A Phrenologist, V. J. Z., and Crumblethorpe, under consideration.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

Published every Saturday, by W. R. M'PHUN, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of STEUART & PANTON, Cheapside, London; and EDWARD WEST & Co. Edinburgh.

CURLL, PRINTER.

THE GLASGOW MECHANICS' MAGAZINE.

"This is Freethinking, unconfined to parts,
To send the soul, on curious travel bent,
Through all the provinces of human thought;
To dart her flight, through the whole sphere of man;
Of this vast universe to make the tour;
In each recess of space and time, at home;
Familiar with their wonders; diving deep;
And, like a Prince of boundless interests there,
Still most ambitious of the most remote;
To look on truth unbroken, and retire;
Truth in the system, the full orb; where truths
By truths enlighten'd, and sustain'd, afford
An arch-like, strong foundation, to support
The incumbent weight of absolute, complete
Conviction; here, the more we press, we stand
More firm; who most examine most believe."—*Young*.

No. LII. *Saturday, 25th December*, 1824. Price 3*d*.

MR. ATWOOD'S BEAUTIFUL INVENTION, THE MACHINE FOR DEMONSTRATING EXPERIMENTALLY THE NATURE OF THE ACTION OF GRAVITY.

DESCRIPTION OF THE MACHINE FOR ILLUSTRATING THE DOCTRINES OF MOTION. Invented by Mr. Atwood.

This ingenious machine was invented by Mr. Atwood, for the purpose of illustrating the doctrines of accelerated and retarded motion; and by means of it we are enabled to ascertain experimentally, 1. The quantity of matter moved; 2. The moving force; 3. The space described; 4. The time in which the space is described; and 5. The velocity acquired at the end of that time.

This machine consists of a fixed brass pulley or wheel, *a b c d*, moving upon a horizontal axis of steel. Each extremity of this axis rests upon two friction wheels, whose axes are horizontal, and the whole is placed upon a platform C D, placed at the top of a vertical pillar C Q, whose base can be put into a true horizontal position by the screws *s*, *s*, *s*. The height of the machine is about eight feet, the greatest diameter of the wheel *a b c d* is about seven inches and five-tenths, the depth of the groove upon its circumference about one-fourth of an inch, and the diameter of the friction rollers about five inches.

A pendulum, P W, is carried by the shelf R S T. The plane of the dial plate is parallel to that of the wheel *a b c d*. Between the platform C D and the base *s s* of the pillar C Q, there rises an upright E F, whose section is a rectangular parallelogram, the length of the sides being about one inch and six-tenths, and two inches and one-tenth. The narrowest face is parallel to that of the wheel *a b c d*, and carries a divided scale about 64 inches long, and subdivided into inches and tenths. Three supports, one of which is represented at Z, slide freely upon the rule E F, and may be fixed at any point of it by means of a screw, *s′*, which presses a spring against the vertical face of the upright E F.

1. *Of the quantity of matter moved.*—In order to observe the effects of the moving force, which is the object of any experiment, the interference of all other forces should be prevented; the quantity of matter moved, therefore, considering it before any impelling force has been applied, should be without weight; for though it be impossible to abstract weight from any substance whatever, yet it may be so counteracted as to produce no sensible effect. Thus, in the machine A, B, represent two equal weights affixed to the extremities of a very fine silk thread, stretched over a wheel or fixed pulley, *a b c d*, moveable round a horizontal axis: the two weights A B being equal, and acting against each other, remain in equilibrio; and when the least weight is superadded to either (setting aside the effects of friction), it will preponderate. When A B are set in motion by the action of any weight *m*, the sum A + B + *m*, would constitute the whole mass moved, but for the inertia of the materials which must necessarily be used in the communication of motion.

2. *The moving force.*—Since the weight of any substance is constant, and the exact quantity of it easily estimated, it will be convenient here to apply a weight to the mass A as a moving force. Thus, when the system consists of a mass = 63 *m*, the whole being perfectly balanced, let a weight ¼ oz. or *m*, be applied on the mass A; this will communicate motion to the whole system; by adding a quantity of matter *m* to the former mass 63 *m*, the whole quantity of matter moved will now become 64 *m*; and the moving

force being $= m$, this will give the force which accelerates the descent of $A = \frac{m}{64 m}$, or $\frac{1}{64}$ part of the accelerating force of gravity.

Alterations in the moving force may be easily made in the more elementary experiments, there being no necessity for altering the contents of the boxes A and B; but the proportion and absolute quantities of the moving force and mass moved, may be of any assigned magnitude, according to the conditions of the proposition to be illustrated.

3. *Of the space described.*—The body A, descends in a vertical line; and a scale E F, about 64 inches in length, divided into inches and tenths, is adjusted vertical, and so placed that the descending weight A may fall in the middle of a square stage Z, fixed to receive it at the end of the descent: the beginning of the descent is estimated from 0 on the scale, when the bottom of the box A is on a level with 0. The descent of A is terminated when the bottom of the box strikes the stage Z, which may be fixed at different distances from the point 0; so that by altering the position of the stage, the space described from rest may be of any given magnitude less than 64 inches.

4. *The time of description* is observed by the pendulum X W vibrating seconds; and the experiments intended to illustrate the elementary propositions, may easily be so constructed that the time of motion shall be a whole number of seconds. The estimation of the time, therefore, admits of considerable exactness, provided the observer takes care to let the bottom of the box A begin its descent precisely at any beat of the pendulum; then the coincidence of the stroke of the box against the stage, and the beat of the pendulum at the end of the time of motion, will show how nearly the experiment and the theory agree. There might be various devices for letting the weight A begin its descent at the instant of a beat of the pendulum W; for instance, let the bottom of the box A, when at 0 on the scale, rest on a flat rod, held in the hand horizontally; its extremity being coincident with 0, by attending to the beats of the pendulum, and with a little practice, the rod which supports the box A may be removed at the moment the pendulum beats, so that the descent of A shall commence at the same instant.

5. *Of the velocity acquired.*—It remains only to describe in what manner the velocity acquired by the descending weight A, at any given point of its path, is made evident to the senses. The velocity of A's descent being continually accelerated, will be the same in two points of the space described. This is occasioned by the constant action of the moving force; and since the velocity of A at any instant is measured by the space which would be described by it moving uniformly for a given time with the velocity it had acquired at that instant, this measure cannot be experimentally obtained, except by removing the force by which the descending body's acceleration was caused.

For the purpose of showing the velocity acquired, it will be convenient to use a flat rod, the weight of which is $= m$. Let the bottom of the box A be placed on a level with 0 on the scale, the whole mass being $= 63\ m$, perfectly balanced. Now let the rod, the weight of which $= m$, be placed on the upper surface of A; this body will descend along the scale in the same manner as when the moving force was applied in the form of a circular weight. Suppose the mass A to have descended, by constant ac-

celeration of the force of *m*, for any given time, or through a given space: let a circular frame be so affixed to the scale, contiguous to which the weight descends, that A may pass centrally through it, and that this circular frame may intercept the rod *m* by which the body A has been accelerated from rest. After the moving force *m* has been intercepted at the end of the given space or time, there will be no force operating on any part of the system which can accelerate or retard its motion: this being the case, the weight A, the instant after *m* has been removed, must proceed uniformly with the velocity which it had acquired that instant: in the subsequent part of its descent, the velocity, being uniform, will be measured by space described in any convenient number of seconds.

HISTORICAL ACCOUNT OF THE ORIGIN AND CONSTRUCTION OF STEAM ENGINES.

(Continued from page 345, Vol. II.)

NEWCOMEN'S ENGINE.

Thomas Newcomen, a blacksmith, and John Cawley, a glazier, both belonging to Dartmouth, in Devonshire, were the next persons who effected important improvements in the construction of steam engines. It is difficult to say what share the latter had in these improvements, and therefore the chief merit has been generally ascribed to the former, who had a correspondence with the ingenious Dr. Hooke, respecting a project to produce a moving power on Papin's plan of an air-pump. Hooke, in a letter to Newcomen, dissuaded him from erecting a machine on that principle, but admitted, "that if a speedy vacuum could be made under his second cylinder, the work would be done." The effects of the condensation of steam and its elastic power, were known from the success of Savery's engine, and this led to farther experiments on the subject. Newcomen, and his coadjutor, introduced steam under a piston moving in a cylinder, and formed a vacuum by condensing the steam by an affusion of cold water on the outside of the steam vessel; and the weight of the atmosphere pressed the piston to the bottom of *the cylinder*. This was their first form of the atmospheric engine, the simplest and the most powerful machine that had yet been constructed, except the attempts, that there is reason to believe, were made by the Marquis of Worcester, be esteemed equally entitled to this honour. In this engine, the steam did not, as in the former cases, exert a direct action on the water, or any part of the apparatus, but was merely employed to form a "speedy vacuum" under a piston attached to one end of a lever, the rod of a pump piston or plunger being affixed to the other extremity. The steam generated in a boiler, was admitted through a cock and pipe in the top, into a cylinder under the steam piston, attached by the rod to a lever, or beam, moving on an axis, or fulcrum. This cylinder was placed within another, forming a concentric space round it. The outer cylinder was connected by a pipe to a reservoir, containing cold water, placed above, but at a distance from the cylinder. Another pipe, proceeding from its lower end, was inserted in the well, or second reservoir of cold water. The piston being at the top of the cylinder when filled with steam, the cock is turned, by which all communication is cut

off between the cylinder and the boiler. By opening the cock in the pipe connecting the upper reservoir with the outer cylinder, cold water is allowed to flow into the space between the two cylinders; this cools the inner cylinder containing the steam, which is condensed, and forms a vacuum under the piston. The pressure of the atmosphere meeting no resistance as it did before the steam was condensed, forces the piston to the bottom of the cylinder. By this motion the end of the lever attached to the piston is depressed, and the other end of the lever to which the pump-rod is fixed, is raised, and draws up all the water above the plunger in the pump barrel along with it.

"Now, if we suppose the cold water which has been in contact with the steam cylinder to have condensed all the vapour, the atmosphere will press on the piston with a force equal to that which would be produced by placing about 14¾ lbs. weight on each inch of its surface. If the piston were 62 inches square, this would be about 915 pounds weight, operating to force it downwards; and, if there were no resistance from friction, it follows, that in the same time an equal weight placed at the other end of the lever beam, or a column of water, weighing 915 pounds, would be lifted as high as the steam piston had been depressed in the cylinder."

When the piston arrives at the bottom of the cylinder, the steam-cock is turned to admit the steam. In this engine the force of the steam being only equal to the pressure of the atmosphere, the piston must be raised by other means to the top of the cylinder. This is done by fixing a counterpoise on the pump-rod, which, being thus depressed, raises the steam piston to its former position. During this operation, the cold water cock is shut, and a cock on a pipe leading from the bottom of the outer cylinder to a well, or tank, below, conveys away the water heated by the condensation of the steam. The small quantity of water formed in the steam cylinder by that condensation, is allowed to fall into the same place by another small pipe in the bottom of it. The cylinder being a second time filled with steam, the same operation is repeated, and may be carried on to an indefinite extent. There is a guage pipe in the boiler, as in Savery's engine, and a small pipe from the upper reservoir, through which water flows on the top of the piston to keep it air-tight; this latter contrivance was first used by Newcomen.

Accident produced a fine improvement on this engine, which otherwise might not have been very readily thought of, and created a new era in its construction.

"In an engine which the inventor and his co-patentee set up at Birmingham, when the pumps, &c. at first were working, they were surprised to see the engine go several strokes and very quick together; when, after a search, they found a hole in the piston which let the cold water in, to condense the steam in the inside of the cylinder; whereas before they had always done it on the outside. This fortunate observation gave rise to the fine improvement of condensing by injection, which hence-forward rendered the outer or water cylinder useless."

The pipe proceeding from the cold water reservoir, is inserted in the bottom of the steam cylinder. When the piston is at the top of the cylinder which is filled with steam, the cold water cock is opened, and the water rises in a jet condensing the steam; a vacuum is thus formed with prodigious rapidity beneath the piston, and the pressure of the atmosphere as before, produces a motion downward. The injection water escapes in the same manner as the condensed steam in the former case. Indeed, the action of all the other parts is exactly the same as in the first engine, except that the counterpoise was attached to the lever beam instead of the pump rod.

WATT'S ENGINE.

No improvements of any great moment were made for a length of time, although the atmospheric engine was in the hands of the best mechanics that England could produce, till Watt arose like a splendid meteor in the mechanical world, and led himself and his country to unbounded wealth and immortal fame.

" 'My attention,' says Mr. Watt, 'was first directed in 1759 to the subject of steam engines by Dr. Robison, then a student in the University of Glasgow, and nearly of my own age. Robison at that time threw out the idea of applying the power of the steam engine to the moving of wheel carriages, and to other purposes; but the scheme was not matured, and was soon abandoned on his going abroad.

" 'In 1761, or 1762, I made some experiments on the force of steam in Papin's digester, and formed a species of steam engine, by fixing upon it a syringe one-third of an inch in diameter, with a solid piston, and furnished also with a cock to admit the steam from the digester, or shut it off at pleasure, as well as to open a communication from the inside of the syringe to the open air, by which the steam contained in the syringe might escape. When the communication between the syringe and digester was opened, the steam entered the syringe, and by its action upon the piston raised a considerable weight (15 lb.), with which it was loaded. When this was raised as high as was thought proper, the communication with the digester was shut, and that with the atmosphere opened; the steam then made its escape, and the weight descended. The operations were repeated; and, though in this experiment the cock was turned by hand, it was easy to see how it could be done by the machine itself, and to make it work with perfect regularity. But I soon relinquished the idea of constructing an engine upon this principle, from being sensible it would be liable to some of the objections against Savery's engine; for the danger of bursting the boiler and the difficulty of making the joints tight; and also that a great part of the power of the steam would be lost, because no vacuum was formed to assist the descent of the piston.' "

In the winter of 1763–4, having occasion to repair a model of Newcomen's engine, belonging to the Natural Philosophy Class in this University, then taught by Professor Anderson, his attention was again directed to the subject.

" 'At that period,' he informs us, 'his knowledge was derived principally from Desaguliers, and partly from Belidor. He set about repairing the model, as a mere mechanician; and, when that was done and set to work, he was surprised to find that its boiler was not supplied with steam, though apparently quite large enough (the cylinder of the model being two inches in diameter, and six inches stroke, and the boiler about nine inches in diameter): by blowing the fire it was made to take a few strokes, but required an enormous quantity of injection-water, though it was very lightly loaded by the column of water in the pump. It soon occurred to him that this was caused by the little cylinder exposing a greater surface to condense the steam than the cylinders of larger engines did, in proportion to their respective contents; and it was found that, by shortening the column of water, the boiler could supply the cylinder with steam, and that the engine would work regularly with a moderate quantity of injection. It now appeared that the cylinder being of brass, would conduct heat better than the cast-iron cylinders of larger engines, (which were generally lined with a stony crust,) and that considerable advantage could be gained by making the cylinders of some substance that would receive and give out heat the slowest. A small cylinder, of six inches diameter and twelve inches stroke, was constructed of wood previously soaked in linseed oil, and baked to dryness. Some experiments were made with it; but it was found that cylinders of wood were not at all likely to prove durable; and that the steam which was condensed in filling it, still exceeded the proportion of that which was required for engines of larger dimensions. It was also ascertained, that unless the temperature of the cylinder itself were reduced as low as that of the vacuum, it would produce vapour of a temperature sufficient to resist part of the pressure of the atmosphere. All attempts therefore to produce a better exhaustion, by throwing in a greater quantity of injection water, was a waste of steam, for the larger quantities of injection cooled the cylinder so much, as to require quantities of steam to heat it again, out of proportion to the power gained by having made a more perfect vacuum; and on this account the old engineers acted wisely in

loading the engine with only six or seven pounds weight on each square inch of the piston.'

"By subsequent experiments, Mr. Watt also ascertained that steam was about 1800 times rarer than water. In another experiment, being astonished at the quantity of water required for the injection, and the great heat that it had acquired from the small quantity of water in the form of steam, which had been used in filling the cylinder; and not understanding the reason of it, 'I mentioned it,' he says, 'to my friend Dr. Black, who then explained to me his doctrine of latent heat, which he had taught for some time before this period (summer 1764); but having myself been occupied with pursuits of business, if I had heard of it, I had not attended to it, when I thus stumbled upon one of the material facts upon which that beautiful theory is founded.'

"On reflecting further, it appeared to him that in order to obtain the greatest power from the steam, the cylinder should always be kept as hot as the steam which entered it; that when the steam was condensed, the water of condensation and the water of injection should be cooled to 100 degrees Fahrenheit, or lower if possible.

"The means for accomplishing these two grand objects did not present themselves to Mr. Watt at the moment when he had drawn those sagacious inferences; but it occurred to him, early in the year 1765, 'that if a communication were opened between a cylinder containing steam, and another vessel which was exhausted of air and other fluids; the steam, as an expansible fluid, would immediately rush into the empty vessel, and continue to do so until it has established an equilibrium; and if that vessel were kept very cool by an injection or otherwise, more steam would continue to enter, until the whole was condensed.'

"ADMIRABLE INVENTION!

"Thus was accomplished what had been considered impossible by all previous engineers,—the production of a vacuum without cooling the cylinder.

"But if both of the vessels be exhausted, or nearly so, how were the injection-water, and the air entering with it, and also that produced by the condensation of the steam, to be extracted from them? This, Mr. Watt proposed to do, by adapting to the condenser, a pipe, whose length would exceed that of the length of a column of water equivalent to the pressure of the atmosphere, and to extract the air by means of a pump, or to employ a pump to extract both the water and the air.

"Instead of keeping the piston tight by water, which could not be applicable in this new method, as, if any of it entered into a partially exhausted and (now) hot cylinder, it would boil, and by generating vapour, prevent the production of a vacuum, besides cooling the cylinder, by its evaporation during the descent of the piston, he proposed to lubricate the sides and keep the piston air-tight, by employing wax or tallow.

"It next occurred to Mr. Watt, that, the mouth of the cylinder being open, the air which entered to act on the piston would cool the cylinder, and condense some steam on again filling it. Then he proposed, 'to put an air-tight cover on the cylinder, with a hole and stuffing-box for the piston to slide through, and to admit steam above the piston, to act upon it instead of the atmosphere.'

"This was his second grand improvement; and while the power of the mechanism remained untouched, the expense of fuel or waste of steam was reduced to nearly a third of its former amount; and the machine was now, properly, an engine, acting by the force of steam—the motive power being derived hitherto from the gravity of the atmosphere.

"The other source of the loss of heat, by the air of the atmosphere cooling the cylinder externally, which produced a condensation of the internal steam, was obviated in thought by enclosing the steam cylinder in another of wood, or of some other substance, which would conduct heat slowly.

"When once the idea of separate condensation was started, all these improvements, continues this admirable mechanic, were suggested in quick succession; so that, in the course of one or two days, the invention was so far complete in his mind, and he immediately began to submit them to the test of experiment.

"The model he used consisted of a brass syringe $1\frac{3}{4}$ inch in diameter, and ten inches long; having a cover at top and bottom of tin plate, a pipe to convey steam to both ends of the cylinder from the bottom, and a second pipe to convey the steam from the upper end of the cylinder to the vessel in which the steam was to be condensed. To save apparatus, the cylinder was inverted. A hole was drilled longitudinally through the axis of the stem of the piston, and a valve was fixed at its lower end, to permit the water produced by the steam which was condensed at first entering the cylinder to escape. The condenser was made of

two pipes of tin plate ten or twelve inches long, and about a sixth of an inch in diameter, placed perpendicularly, and communicating at top with a short horizontal pipe of large diameter, shut at its upper end, with a valve opening upwards. These pipes were joined at bottom to another perpendicular pipe about an inch in diameter, which served for the air and water pump. These pipes and pump were all placed in a cistern filled with cold water.

"The steam pipe was attached to a small boiler. When the steam was generated, it filled the cylinder, and soon issued at the longitudinal perforation of the rod, and through the valve into the condenser: when it was judged the air was expelled, the steam cock was shut and the air pump piston rod was drawn up, which leaving a vacuum in the condenser pipes, the steam entered them and was condensed: the piston of the cylinder immediately rose and lifted a weight of about eighteen pounds, which was hung to the lower end of the piston rod. The exhaustion cock was shut, the steam was re-admitted into the cylinder, and the operation was repeated; and excepting the non-application of the steam case, and external covering to prevent the dissipation of the heat by radiation, the invention was complete as far as regarded the savings of steam and fuel. To verify the expectations that Mr. Watt had formed of the advantages of his invention, he constructed a large model with an outer cylinder and wooden case, the effect of which exceeded his most sanguine expectations.

"This form of the condenser was afterwards changed; it being found that to condense the steam used in a large engine by the cold water being applied on the outside of the condenser, would require vessels of large and very inconvenient dimensions. And it was also found that, from the nature of the water with which the engines are frequently supplied, a stony crust was quickly formed upon the outside of the iron plate of the condenser, which greatly diminished, or altogether destroyed, its conducting power."

With the assistance of Dr. Roebuck, the founder of Carron Iron Works, Mr. Watt was enabled to erect one of his engines at a coal-mine at Kinneil, near Borrowstonness. It had a cylinder of 18 inches, "and being a sort of experimental engine, was successively altered and improved till it was brought to considerable perfection." In 1768, he applied for a patent, and the following is an extract from his specification.

"'My method of lessening the consumption of steam, and consequently fuel in fire engines, consists in the following principles: First, that the vessel in which the powers of steam are to be employed to work the engine, which is called the cylinder in common fire engines, and which I call the steam vessel, must, during the whole time the engine is at work, be kept as hot as the steam which enters it; first, by enclosing it in a case of wood, or any other materials that transmit heat slowly; secondly, by surrounding it with steam or other heated bodies; and, thirdly, by suffering neither waste, or other substance colder than the steam, to enter or touch it during that time. Secondly, in engines that are to be worked wholly or partially by condensation of steam, the steam is to be condensed in vessels distinct from the steam vessel or cylinders, though occasionally communicating with them. These vessels I call condensers, and whilst the engines are working, these condensers ought at least to be kept as cold as the air in the neighbourhood of the engines, by application of water or other cold bodies. Thirdly, whatever air or other elastic vapour is not condensed by the cold of the condenser, and may impede the working of the engine, is to be drawn out of the steam vessels or condensers by means of pumps, wrought by the engines themselves, or otherwise. Fourthly, I intend in many cases to employ the expansive force of steam to press on the pistons, or whatever may be used instead of them, in the same manner as the pressure of the atmosphere is now employed in common fire engines. In cases where cold water cannot be had in plenty, the engines may be wrought by this force of steam only by discharging the steam into the open air, after it has done its office. Fifthly, where motions round an axis are required, I make the steam vessels in form of hollow rings, or circular channels, with proper inlets and outlets for the steam, mounted on horizontal axles like the wheels of a water-mill. Within them are placed a number of valves, that suffer any body to go round the channel in one direction only: in these steam vessels are placed weights, so fitted to them as entirely to fill up a part or portion of their channels, yet rendered capable of moving freely in them by the means hereinafter mentioned or speci-

fied. When the steam is admitted in these engines between these weights and the valves, it acts equally on both, so as to raise the weight to one side of the wheel, and by the re-action on the valves successively to give a circular motion to the wheel; the valves opening in the direction in which the weights are pressed, but not in the contrary. As the steam vessel moves round, it is supplied with steam from the boiler, and that which has performed its office may either be discharged by means of condensers, or into the open air. Sixthly, I intend in some cases to apply a degree of cold water not capable of reducing the steam to water, but of contracting it considerably, so that the engines shall be worked by the alternate expansion and contraction of the steam. Lastly, instead of using water to render the piston or other parts of the engines air or steam tight, I employ oils, wax, resinous bodies, fat of animals, quicksilver, and other metals in their fluid state.'

"These improvements were combined in a very masterly manner, in what were called his single reciprocating engines. The lever beam, boiler, pump rod, and the use of a plug frame to act by its pins or tappets on the hand-gear, or contrivances for opening and shutting the valves, with some improvements in their arrangement, were retained; the valves were, however, on a different and a better construction."

To obviate the inconvenience of the returning stroke, was the only thing that was left for Mr. Watt to do, to render his engine perfect; and he accomplished it by a very slight extension of his first idea.

"He had introduced steam acting against a piston to press it downwards; he now formed a communication between both sides of the piston and the boiler, and also with the condenser, and made the steam act to press the piston upwards as well as downwards.

"The mechanism was now, as far as the principle went, perfect; and it was freed, for the first time, from the enormous dead weight of counterpoises, which had hung on it from the first attempts of Newcomen; and the equally enormous load which was used in the construction of the various parts, for the purpose of equalizing the motion."

The engraving in our last is a representation of a complete double acting steam engine, on this principle, as it is now generally constructed for the purpose of rendering it perfectly independent and unconnected with the building to which it may belong.

a, a, is a long narrow box or case formed by screwing plates of cast iron together so as to form a base or support for the whole machine to rest upon. A part of this base is furnished with a close bottom as from *b* to *b*, and an upright partition at *c*, so as convert the part *a, b, b, c,* into the cold water cistern. Immediately over this cistern the steam cylinder *d*, is fixed, and directly under it the condenser *e*, and air pump *f*; *g, g,* are the side pipes receiving their steam from the steam pipe *h*, which proceeds from the boiler A, and this is equipped with all the necessary contrivances; *i, i, i,* are cast iron columns, four of which are placed in the angles of the base to strengthen it, and two in the centre.—They are for supporting the entablature plates or spring beams *k, k,* upon which the beam *l, l,* is mounted, and to which the radius rods of the parallel motion *m*, are attached; *n*, the piston rod of the steam cylinder, and *o*, that of the air pump, which in this instance also operates as the plug-tree, by carrying the two tappets *p, p,* which act upon the lever *r*, for admitting or shutting off the steam. The hot water cistern is shown at *q*, *s* being the hot water pump, and *v*, the rod by which it is worked from the main beam; *u*, is the cold water pump, worked in a similar manner; B, the fly-wheel, the shaft or axle of which is supported on the top of the base *a, a,* while its crank works within it, and is connected by the connecting rod C, with the end of the beam; *w, w,* is the governor, worked by the line 1, 1, and operating on the throttle valve *x*, by the rods 2, 2; *y*, is the handle and index plate of the injection cock, and *z*, the barometer of the condenser, fixed against one of the iron columns.—The parts of the boiler are as follows: 3, is the man-hole, 4, the feed pipe, 5, the fire place, 6, 6, the chimney, 7, the gauge cocks, and 8, the steam gauge.

Such is the nature and construction of the most powerful engine ever invented by man. It has conferred immortal honour on the inventor, and imperishable renown on the country that gave him birth. Glasgow, the scene of his early labours, and the fostering parent of his genius, will for ever share in

those envied laurels which still hover around his departed head. If the ancient states of Greece and Rome decreed statues and honours to him who died nobly defending his country, how much more ought we in this happy land to decree, and to unite in erecting a monument to the memory of the man who has, by his powerful inventions, raised it to such a gigantic height in the scale of nations?

AN IMPORTANT DISCOVERY,
THE GREATEST EVER MADE IN NAVIGATION.

From the different bearings of the Magnetic Needle on the different places of the earth and seas, and from its steady adherence, very nearly, to one and the same position, on any one certain place, it is now discovered that the needle has, at all times, since the attraction was found out, constantly and uniformly pointed to one certain point, and that now for the long period of 244 years. From this important fact, it is no more than reasonable to conclude, that it will continue to do so till the end of time. Now, at London, the needle bears 31 degrees west of the pole of the earth, and farther north on the same meridian the variation west is increased. The meridians east of London have a greater variation west, to the extent of 9 degrees; and 10 degrees east of London, it begins to diminish; west of London the variation is less and less, as far as 81 degrees, where there is no variation. From the equator to either of the poles, the variation increases; west of 81° west of London, the variation is east to the extent of 90°; and there the variation is at its fullest amount; it then decreases during 90°; where again there is no variation. Now, from these bearings of the needle so many different ways, it may appear, at first sight, that it cannot be at all times pointing to one particular and certain spot, and yet it is a certain fact. The difficulty that has hitherto puzzled the learned in Europe in this matter, consists in their ignorance of the PLACE of the attractive power, which is now discovered to be situated 23 DEGREES distant in space from the pole of the earth, and directly north from the place where there is no variation; it is also found that the attractive power, or pole, has an orbit of its own, on which it performs a daily revolution in the same manner as the earth, but that it takes a very small fraction of time more than 24 hours to perform it, whereby it loses a very little on the earth. By this means, in course of time, it takes a different bearing on all places of the earth and seas, by progressively falling back on its orbit, and this is the cause of variation on the same spot of the earth.

Now, the fact of its always bearing to the same point, notwithstanding the many variations experienced, remains to be accounted for. There are three points to be considered in this explanation; first, the magnetic pole; next, the pole of the earth; and the third point is the place of the earth, or sea, where the observation is taken. Where there is no variation, the three points are all on one direct line; at either side of the meridian, of no variation, a line drawn from the place of observation to the magnetic pole, makes an angle with a line drawn from the same place to the pole of the earth. At places near the meridian, of no variation, the angle is small; farther off from it, the angle is greater; and farther off, and more northerly, great-

ese angles are the differ-
ies of variation.
ow naturally be inquired,
new magnetic pole found,
ever been seen, nor has
en given by astronomers?
may be answered, that
is visible or invisible, is
tion; but, allowing it to
le as the sun, it never
en at any place south of
degree of latitude; and
no higher than the ho-
eenland ships, for a long
ous to this period, have
and even farther north,
riners could not possibly
ing day, or sun light,
. It may now, perhaps,
some of the present ex-
the Polar regions, if they
on to look for it. The
of this power, so low,
any horizons to the south
he increase of its power,
hing towards it, fully ac-
he droop of the compass
tudes; and I know not
ower may be another
e added to the astrono-
If the magnetic pole was
3 degrees from the earth,
n would be greater than
o be; and, if nearer, the
ould be less than it is
by experience.
w suggest a few things
enefit and immense ad-
ing to navigation by this
Tables of the variations
tudes and longitudes of
f the globe, can be made
n, whenever latitude in,
iation in the place of ob-
re ascertained, the longi-
rked beside them on the
is plan will, of course,
he use of chronometers,
uble of finding the time
, and prevent errors to
aking of that time is lia-
rhaps, may be counted

absurd to depend on such a variable thing as the compass, which has always been found to point so many different ways; but it is evident, that its many variations are not in the least applicable to itself, but to the different positions to which it is, and has been carried, as already shown. Nothing can be more steady than it has proven itself to be, in every spot where it has been placed and kept for a number of years, and attended to with the greatest care; this fact is witnessed by its steadiness at London for 244 years. This, however, with the exception of the small variation caused by the attractive power falling back on its own orbit, almost imperceptibly, as already pointed out, and the variation occasioned thereby, is so inconsiderable, that it will not, on an average, make one degree in seven years. During some years, no doubt, there will be a greater variation than in others, according to the position of the magnetic power on its own orbit. At present, and for years to come, in this country, it will not amount to 4′ per year. In short, if the compass is steady on one place, there is no reason why it should not be so on all places; if unsteady on any place, why it should not be unsteady on all places. But from every circumstance connected with the variation, it is proven to be as steady and sure as any thing in nature. So that, on the whole, this is the discovery of the longitude, so long sought after, and for which great ingenuity and much trouble and expense have been laid out, in inventing and providing substitutes.

U. S. C.

[This appears to us a very ingenious theory, and one that is more likely to account for the variation of the needle than the hypothesis of Dr. Halley and others.]

ON THE CHEMICAL PROPERTIES OF MILK, WITH REM ON THE LACTOMETER.

MILK is a fluid secreted by animals of the mammiferous kind, by a peculiar set of small glands generally clustered together if on the breast, in a row, if on the belly; and around a tube, as in the œsaphagus of the common pigeon. It is distinguished by its white opaque colour, and its sweet bland agreeable taste, destined for the nourishment of their young. Its smell is also peculiar, though not disagreeable, especially when fresh drawn. It is heavier than water, hence it sinks in that fluid. Its specific heat is 98, water being 100.

Berzeius has given the following analysis of it in his animal chemistry, though he has not said from what animal it was taken:

Water,........................	928.75
Curd with a little Cream,	28.00
Sugar of Milk,..............	35.00
Muriate of Potash,..........	1.70
Phosphate of Potash,.......	0.25
Lactic acid, Acetate of Potash, with a trace of Lactate of Lime,..............	6.00
Earthy Phosphates..........	0.30
	1000.00

Milk is capable of undergoing the vinous, acetous, and putrefactive fermentation. The Arabs prepare a wine, called "Leban," the Turks one called "Yaourt," and the Tartars one called "Koumiss," from it. They take a very large quantity of mare's milk, add one-eighth of sourest cow's milk they can obtain, a small quantity of the "wine" already prepared, or a small quantity of yeast, cover the vessel with a close cloth, and keep it in a moderate heat for 24 hours. Then they beat it with a bunch of rods to mix it thoroughly; lastly, they put it in a clean, high, and narrow vessel, and repeat the beating or shaking if it is not all alike in consistence. It is then put in clean bottles and kept in a cool place. I be shaken again before usin is then a very pleasant drir spirit may be extracted fro distillation. Every body is of the acetous fermentatio keep milk 36 or 48 hours in s in a close vessel, and it will distinctly; and if this be ke 5 days under the same circu ces, the putrifactive ferme will have begun. All acids, and the peculiar secretion of ner coat of the stomach, es of the young mammiferous a and some few other substanc the power of coagulating it. a kind of soap with alkalies. product of coagulation is cu whey. Curd consists, accor the analysis of MM. Gay, and Thenard, of

Carbon,........................	5
Oxygen, ...	1
Hydrogen,....................	
Azote,.........................	2
	10

Whey contains a great pro of water, a small quantity of cheese, saccharine matter, an acid, which last reddens ve blues. For the method of ing it, see Ure's Dictionary mistry, article Acid Lactic.

The saccharine matter, upo depends its property of ferme is held in solution by the wh is obtained by evaporation in proper moulds, to the con of honey, and afterwards the sun. In this state it is e by the Swiss. Milk may be rated in the same way, and sea as a substitute for milk, r it with water when wanted It is not agreeable to the pa those who have been used t ter. It must be kept dry to

spoiling. If it is wanted pure, it must be dissolved in water, clarified with white of eggs, or any albuminous substance, afterwards evaporated to the consistence of honey or thin syrup. When small rhomboidal parallelopipedon white chrystals will form.

"Sugar of milk has a faint saccharine taste, and is soluble in 3 or 4 parts of water. It yields by distillation the same products that other sugars do, only in somewhat different proportions. It is remarkable, however, that the emyreumatic oil has a smell resembling flowers of Benzoin. It contains an acid called the saccho-lactic, but as it is common to all mucilaginous substances, it has been termed the Mucic." Ure's Dict. p. 590. For process of obtaining this acid, see Ure's Dict. article Acid Mucic. Any of the other ingredients can be procured according to the principles of chemical analysis.

ON THE LACTOMETER.

This is an instrument for knowing the comparative strength or richness of milk and cream. I believe there have been various instruments invented for this purpose. It has not been my good fortune, however, either to see them, or a description whereby a similar might be made. Its utility is self-evident, both for the dairy and private families. For the dairy maid to know the strength of the milk; the milk of one cow compared to that of another, whether it is richer in one pasture than another; and whether morning or evening meal, as it is technically called in the dairy, is the best; how much cream and butter is to be got from a known quantity, from trials made before of the same cow's milk, and how far it may be diluted in the process of churning, for the obtaining the butter soon, and of a good quality. This must all be learned from comparative trials. In short, I should consider it as useful as a thermometer, an indispensable instrument now in all well regulated dairies, to private families to know the strength of the milk, that they may not be imposed on, as they are generally in large towns. The fact is notorious, that we obtain more cream, and of a better quality, from the same quantity of milk, in the country, than in large towns. How can we be sure, without an instrument of the kinds to be described, or some other of the same description? It is a common practice of the cowfeeders in Glasgow, and other large towns, to have warm water in the dish, and to draw the milk over it, so that it mixes intimately. A gentleman who got his milk from a cowfeeder in town, had heard they practised this, and also suspected it, and who usually got it in a pannikin, sent two one morning, one for the milk, the other for the warm water. This had the desired effect, and they never afterwards attempted to deceive him. How could he have determined the amount of the deception, but by means of a lactometer?

There are four plans which occurred to me might answer the purpose of the lactometer:

1st, Wheel and axis, or lever of first kind.

2d, The roman statera or steelyard, which is nothing else than a lever of the second kind.

3d, The instrument used by honey dealers for weighing the beehives.

4th, The hydrometer, or instrument used for ascertaining the strength of spirits, as used by the excise

1st. The wheel and axis, or lever of the first kind. On the wheel I have a fixed point, and to it I tie a thread, the lighter the better, provided it support the weight. To

the thread on each end is a small hook, one to hang the small jug to contain the milk and cream to be tried, the other for a known weight. The jug is filled and hung on one of the hooks, and the weight on the other, and according as the milk or cream is strong or weak, so will it point on a dial with an index placed on the wheel. This, if correctly made, answers very well. Another may be made with a common balance, if delicate enough. The stronger the milk or cream, the more will the weight preponderate.

2d. The roman statera, steelyard, or lever of the second kind. The small jug containing the milk or cream to be tried, is hung on a small notch on the short arm of the lever. The weight on the other arm is shifted nearer or farther from the fulcrum, until it is exactly horizontal, as shown by the point in the middle, or small notches numbered off, 1, 2, 3, 4, 5, 6, &c., which numbers tell exactly the strength from experiments made previously.

The better the cream or milk, it will be found the lighter, or the weight will be so many degrees nearer the fulcrum. A gill of best cream, or 4 oz. avoirdupois by measure, compared to water, weighs exactly 3 oz. and 30 grs.; milk more in proportion to its quality.

3d. The instrument used by honey dealers for weighing their bee-hives. You take a small jug of a given size, and fill it brim full with the best cream, then with that of an inferior quality, then milk, and so on with it, until you come to half milk and half water, the point where it was seen from the bottom of the tube, being marked off in each with a file, and numbered if required. It is now fit for use anywhere. This is the most convenient for dairies and private families, being least liable to go wrong.

4th, The hydrometer used by the excise for ascertaining the comparative strength of alcohol or spirits. This must be graduated like the preceding first best cream, and gradually reducing, until you come to half milk and half water, each being marked off. It is then ready for use.

Dr. Ure, p. 590 of his Dictionary, article Milk, says, "Since both cream and water affect the specific gravity of milk alike, it is not possible to infer the quality of milk from the indication merely of a specific gravity instrument. We must first use as a lactometer, a graduated glass tube, in which we note the thickness of the stratum of cream, afforded after a proper interval, from a determinate column of new milk. We then apply to the skimmed milk, a hydrometric instrument, from which we learn the relative proportions of curd and whey. Thus the combination of two instruments furnishes a tolerably exact lactometer." I differ in opinion with the Dr. respecting the first instrument, and the second is too complex for common use, in fact to all who are not acquainted with making chemical experiments.

S.

SPECIMEN OF THE GEOMETRICAL EXERCISES

Performed by the Students of the Mathematical Class, Anderson's Institution.

(Continued from page 285, Vol. II.)

1. Theorem. If two lines meet in the same point, on opposite sides of a given straight line, and make the vertical angle equal, they will form a straight line.

2. Problem. From two points on the same side of a line, given in position to draw two lines, which will meet at a point in that line, and make equal angles with it.

3. Theorem. The sum of two lines drawn as in the foregoing, is a minimum.

4. Problem. From two given points to draw two equal lines, which shall meet in a point in a line given in position.

5. Theorem. Any side of a triangle is greater than the difference betwixt the two other sides.

6. Theorem. The diagonals of a rhombus bisect each other at right angles.

7. Of all the lines which can be drawn to a given line, from a given point without it, the perpendicular is the least, and those that are nearer to it, are always less than the more remote; and no two lines on the same side of the perpendicular can be equal.

8. Problem. Given the base, and the two angles at the base, to construct the triangle.

9. Problem. To trisect a right angle.

10. Problem. To trisect a given line.

11. Theorem. If the exterior and one of the interior and opposite angles of a triangle be bisected, and the bisecting lines produced till they meet, they will form an angle equal to half the other interior and opposite angle.

12. Theorem. If from any point in an equilateral triangle, perpendiculars be drawn to the three sides, the sum of these perpendiculars is equal to the perpendicular of the triangle.

13. Theorem. In any triangle, if a perpendicular be let fall from the vertex to the base, the difference of the squares of the sides is equal to the difference of the squares of the two segments of the base.

14. Problem. To construct a square that shall be equal to two given squares.

15. Problem. To construct a square that shall be equal to the difference of two given squares.

16. Problem. To make a triangle equal to a given parallelogram.

17. Problem. To make a triangle to any four-sided figure, five-sided figure, &c.

18. Problem. To divide a triangle into two equal parts, from any point in one of its sides.

19. To divide a trapezium into two equal parts, from a point in the middle of a side.

20. Problem. To divide a trapezium into two equal parts, from any given point in a side.

21. Theorem. The three exterior triangles formed by joining the angles of the squares, as constructed in the 47th of Euclid, are each equal to the interior right angled triangle.

22. Required the height of a tower, and also the distance of its summit from the place of observation, 120 yards from the bottom of the tower, supposing the angle of elevation at the same place to be 30° 15′.

To find the height.

As radius..................	10.000000
Is to tan. 30° 15′.........	9.765805
So is the base 120.......	2.079181
To height 69.98..........	1.844986

To find the distance.

As radius..................	10.000000
Is to sec. 30° 15′.........	10.063569
So is the base 120.......	2.079181
To distance 138.915......	2.142750

Therefore the height of the tower is 69.98 yards, and the distance of its top, from the place of observation, 138.915 yards.

THE DIVING BELL AT PORT-PATRICK.

CONNECTED with the bell is a dismasted vessel of some fifty or sixty tons burthen, in the centre of which a pretty strong crane (worked as usual with tooth and pinion), is

sunk to the very keel, and by the help of which the instrument is let down or taken up, with the greatest ease and regularity. When not in use it rests upon the deck; but when the weather is favourable, the vessel is moved to whatever station the diver directs, and then down go the aquatic quarrymen.

The bell is neither more nor less than a strong cast metal frame, four inches thick in the side, 5 feet 3 inches high, 4 feet 5 inches wide, tapering towards the top, and weighing exactly 3 tons 15 cwt. The tube of the air-pump, 3 inches in diameter, is inserted at the top, and is covered in the inside by a leather valve, with a view to the equal distribution of the air. The pump, which is a double one, is placed on the deck, and constantly worked by four men whenever the divers are at any great depth. In the top are rivetted two strong iron bolts, formed into rings at the extremities; the upper rings connect the bell with the chain of the crane, and the under ones are used for an important purpose which I shall by and by explain. In casting the bell, ten different holes had been purposely left, which are filled with as many circular windows, thoroughly cemented or puttied in—exactly such as you sometimes see used on board of ship, and which the country people call *yokes of glass*. In the inside are seats *vis-à-vis*, with a cross spar to rest your feet on, and sundry knobs around the top, from which are suspended the workmen's tools. When about to descend, the bell is gradually raised and lowered over the vessel's side. If at any time the person who descends feels a little squeamish, it is probably when he first takes his seat in the bell; he sees himself pent in a narrow house; he hears the air valve whizzing above; around are nothing but iron walls; below is the level or slightly agitated sea, and he knows not exactly what may be his sensations when he actually comes in contact with a new element. Arrived at the bottom, the diver gives the usual signal, by striking with a hammer on the side of the bell, and in a minute the iron ship is safely moored. The most remarkable thing of all, is the mode of placing the huge masses of free-stone, which form the foundation of the pier, and each of which weighs from 5 to 7 tons. When the bed is prepared and a stone is meant to be laid, it is first of all placed on a punt, and from it lowered to the proper situation—or as nearly so as the diver can direct. He then descends, and by shifting about gets the bell suspended right above the stone, and forthwith disengaging the original tackle, he attaches to it an ingenious apparatus of his own, the chain of which is fastened to the rings mentioned above, and in this way he drags the stone wherever he pleases. Nay, so easily are the stones moved while afloat in the water, that the slightest touch sends them this way or that—as, when every thing is prepared, it is easier to build below than above water. No cement nor fastenings are used to connect the stones. From their great gravity and the slightness of the motion felt at such depths, there is no danger whatever of their shifting, while the heavy superstructure that is to be erected above, will tend equally to keep them firm. Independently of the pumpers and hands that work the vessel, there is another individual, whose sole duty is to watch the signals. These are reduced to a perfect system, and may be explained in half a dozen words. When the diver requires more air, and wishes the motion of the pump to be quickened, he strikes *One* on the inside of the bell, which is easily heard above even at the greatest depths. *Two* means the bell has come in contact with something, and you must either stop, or turn the windlass; *Three* is the signal for pulling up; *Four* means let the bell lower down; *Five* is the signal for hawling to the eastward; *Six* to the westward; *Seven* to the southward; *Eight* to the northward; and *Nine* means let down the working bucket. Besides these there is a *Tenth* signal, but which as yet there has been no occasion to give at Port-Patrick.

NOTICES TO CORRESPONDENTS.

W. S., W. C., and Rusticus, have been received.—The acrimonious and petulant attack on the memory of Professor Anderson, by B., is inadmissible.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of Steuart & Panton, Cheapside, London; and Edward West & Co. Edinburgh.

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THE GLASGOW
MECHANICS' MAGAZINE,

CONDUCTED BY

A Committee of Civil Engineers and Practical Mechanics.

" From scenes like these old *Scotia's* grandeur springs
That makes her lov'd at home, rever'd abroad :
Princes and lords are but the breath of kings,
' An honest man 's the noblest work of God.' "—*Burns.*

No. LIII. *Saturday, 1st January,* 1825. Price 3*d*.

HARRIOT'S ENGINE.

A YEAR has now elapsed since the commencement of this Magazine, during which time it has raised itself into a circulation, not only far exceeding any thing which Glasgow has hitherto produced, but greater than that of any provincial periodical of the same kind in the Kingdom. In entering on the labours of another year, the Publisher has to inform his numerous Readers, that the Editor who formerly conducted this Work, has now no farther connection with it; and he with satisfaction announces, that he has formed an arrangement with a Committee of *Civil Engineers and Practical Mechanics*, under whose direction and advice the Work will hereafter be exclusively conducted. He is quite conscious, that notwithstanding every exertion has been used to make it worthy the extensive patronage it has received, that it is far from being perfect, and that much may yet be done to improve it: anxious, therefore, not only still to merit this patronage, but yet farther to increase its circulation, and thereby its value and its usefulness, he assures the Public, that no increased exertion will be spared either on his part, or on the part of the Gentlemen who now conduct it.

In an age such as this, when knowledge and science pay daily visits alike to the humblest Cottage, as to the proudest Palace, when Peer and Peasant, Master and Workman, are alike votaries at the shrine of learning, the conductors are fully conscious of the arduous nature of the task they undertake, in attempting to give information or instruction to a people on whom the day-star of useful knowledge already shines so bright and so beautiful;—a people, many of whom are more competent to be instructors, than myriads of those who attempt it. But great as the task is, and observing, as they know the public eye must necessarily be to all their defects, they are determined only to increase their labours to keep up with the advance of mind, and to make this little work worthy the patronage of a great and an enlightened people. They believe they may with confidence assert, that limited as the nature of the work unavoidably is, by their united labour, they will be enabled to make it much more useful to the practical Mechanic, and much more valuable to the man of science, than it has even hitherto been.

In thus speaking of the thirst for knowledge which at present pervades the body of the people, and which will form, in after ages, when the petty broils and factions which now engage the attention of so many wise and learned heads, are unheeded or forgotten, not only the most distinctive, but certainly the most beautiful point in the character of the time, it is impossible to pass over in silence the interesting account which will be found in our present Number, (from the pen of Mr. Bannatyne,) of the Institution at the Gas Company's Works, for the mutual instruction of the workmen. We most cordially join in all the philanthropic and enlightened views of the Gentleman who so ably pleads the cause of the workman with his master; and we sincerely trust, that if not all, that many of them will be inclined, as well for their own interest as for the comfort and happiness of the men, to follow the laudable example of the Gas Company, and patronise such institutions in their respective works. To Mr. Neilson, the intelligent engineer who manages the Company's works, we are indebted for this extraordinary school of learning: but for his perseverance, and his fostering though unobtrusive care, we in all likelihood would never have been gratified with the beautiful

and interesting sight of one workman teaching and instructing his fellow-labourers, and all cheerfully giving, towards the great design of mutual instruction, the aid which his knowledge or his talents enabled him to give. We have, therefore, with cheerfulness and pleasure, given insertion to Mr. B.'s account of the Institution; and we only wish our circulation was increased ten-fold, that we might spread the knowledge of it to the ends of the earth. We trust, however, that our little work may meet the eye of Mr. Brougham, who appears never to weary in the application of his great talents to improving the lot of man; and that, when he next directs his powerful mind to the subject of education, and again illuminates the pages of the Edinburgh Review, with his wisdom, he may give additional value to Mr. Bannatyne's views by noticing the subject of his letter, and recommending it to public attention and imitation.

Before concluding, however, we must say a word or two more as to ourselves. It is quite needless to expatiate on the general utility of such a Magazine as this, as the design is already fully appreciated by the public; and all that is wanting to make it pre-eminently useful and successful, is to make the execution worthy of the design. This we shall undoubtedly attempt; how far we may succeed it will be for the pnblic, not for us, to say. Some have complained that every thing we have printed has not been original; but, in our estimation, this is a property not a fault. We conceive that one great use of such a Magazine as this is, to bring within the reach of the poorest person the spirit and the substance, if not the words, of the most important articles of the numerous and valuable Journals of Science and the Arts, which are daily and hourly issuing from the press; and, so far from this being carried to excess in our pages, we decidedly think that if proper selections had been made, much more valuable information might thus have been given. It will be our business now to present our readers with all that is new or important in these numerous Journals. Reviews of books too, we think, may with much advantage be introduced; and these will much oftener be given than they have hitherto been. Indeed no pains or trouble will be spared to render the whole as practically useful and as scientifically instructive as possible; and thus to merit an increased share of that patronage which is never withheld from what is really deserving of it.

HARRIOT'S ENGINE,

For Raising and Lowering Weights, &c. by the Action of a Column of Water.

Description.

A A, in fig. 1 and 2, is a cylinder with a moving piston therein, of which D is the piston rod.

B and C are water ways through which the water is admitted to communicate with both sides of the piston.

E F, a pipe in fig. 1, through which water descends from a reservoir above, into a three-way cock M, and in fig. 2, is a pipe through which any stream or head of water runs to the three-way valve in the cistern M.

C H is a pipe in both, communicating from the three-way cock, or valve, to the upper part of the cylinder.

K B is a pipe communicating from the same cock, or valve, to the lower part of the cylinder.

I I is a pipe, communicating between the two last mentioned pipes, consequently between the upper and lower spaces of the cylinder, which communication can be either cut off or opened to any requisite degree by the cock L.

N is a pipe in which a lower column of water is suspended by the reaction of the atmosphere, and consequently a power to the upper column or fall, in proportion to its length or depth, not exceeding the weight of the atmosphere.

Remarks.

The nature and principle of the syphon engine consists in combining the power of the syphon with the direct pressure of a column or stream of water, so that they may act together. It works by means of the syphon constantly acting in concert with the feeding stream of water, so that each alternately act on the upper and lower part of a piston, within a cylinder as it were, reversing the syphon at each change; and the power is equal to a column of water of the same diameter as that of the cylinder, and equal in length to the height of the head, above the tail water. For instance, if a column of water of any given diameter has a fall of 20 feet until it reaches an engine, its power is clearly ascertained. Now, whatever that power is, if a syphon pipe be added to this engine, so as to connect with the column, and the syphon pipe has also a fall of an equal length, namely, 20 feet to the lower end, which is immersed in water, the engine, although placed in the mid-way, will then have a power equal to that of a descending column of 40 feet; and should the column or fall to the engine be but 2 feet, and the lower syphon pipe 24 feet, the power would be equal to a fall of 26 feet; and in this manner in various diversity between the falling column and the syphon pipe beneath, the latter will produce an equal power according to its proportionate length, or depth, to the surface of the tail water, provided it does not exceed above 30 feet, or the weight of the atmosphere; and where a stream of water is either level with, or even below, the place at which it is desirable to fix the engine, there will be no difficulty in placing it either below, or on the level, or above the stream itself, provided the height it is fixed above, does not exceed 28 or 30 feet, and the place where the water flows off be still lower. The construction may evidently be varied according to the local situation and circumstances of applying it, and the use to which it may be adapted, in giving activity to different kinds of machinery.

The drawing, fig. 1, exhibits the apparatus for raising or lowering weights of any kind, on wharfs or in warehouses. A man or boy can raise or lower goods of any weight, without other exertion than that of merely turning the three-way cock M, to an index; in either raising or lowering, the *stop* is instantaneous, by a small motion, or turning the cock to the stop mark in the index; this most effectual of stops, or gripe, operates so quietly and easy without any jirk or jarring, that it removes the usual risk attending common cranes or machinery, in which men are sometimes overpowered. It raises and lowers goods with thrice the velocity usually produced by manual labour; yet an engine of dimensions sufficient to raise several tons, may be so graduated by the person at the cock, as to bring it to the smoothest slowest motion possible. The saving of labour and time must therefore be considerable, the risk of plunder diminished, and delays in setting to work for want of help removed.

The great obstacle to the use of the syphon engine, and this was

stated by its inventor, is the want of a head of water in most places where the engine could be used to greatest advantage; but so conscious was he of the advantages of his invention, for raising goods to warehouses and granaries, that he proposed raising water by other means into a reservoir at the top of the warehouse, to be used afterwards in raising the goods. This obstacle appears hitherto to have prevented any attempt to put Mr. Harriot's engine to any practical use; but in Glasgow, where water is raised to the top of the very highest house in the city, we think the syphon engine might be used for many useful purposes, and might save a great deal of human labour. It might be used very advantageously at the Broomielaw, for raising and lowering goods from and to the vessels, when they are loading and unloading.

The drawing, fig. 2, shows how the syphon engine is to be applied to streams of water, the advantages of which are, that the engine, as well as the mill work, or manufacturing machinery it may drive, may be placed where most convenient, above or below the head or stream, to be worked by a fall of water from the least to the greatest height, or by any stream or river, the tail water below acting and having as much power as the head, answering to the height of either.

ON A NEW MECHANICAL AGENT,

Discovered by a Glasgow Mechanic, but announced, by the Editor of the Chemist, as a Discovery of his own.

In No. XLIII. we published a letter from G. M., containing an account of a discovery made by him of a new mechanical agent, obtained by decomposing water by means of Galvanism, and causing a vacuum by igniting the gasses produced, with a detail of its application to propelling steam boats: in our LIV. No., we published a letter from the same Correspondent, in which he stated that this new power had since been boldly announced in the Chemist, as a new invention, without any notice being taken of its having been previously discovered by him, or having appeared in our Magazine. We have since seen the Chemist, No. XXXVII., in which this announcement is made, and we do not hesitate to say, that there is strong reason to believe the discovery is taken entirely from the letter of our Correspondent, who, *therefore, is alone* entitled to it. *The principle is precisely* the same in both; and although it is possible that the same discovery may have been made by both the Editor of the Chemist, and by our Correspondent, there are many reasons which makes this very improbable in the present instance. This discovery came to us in a letter dated the 15th, and was published by us on the 23d of October: it appeared in the Chemist on the 20th of Nov., nearly a month afterwards. It is very improbable, we think, that the Editor of the Chemist did not see the announcement in our Number; and it was too recent to have slipt from his memory where he had obtained it. He calls it a thought which he had hit on: now, surely it is rather curious that this thought should have struck him so immediately after the appearance of the same thing in our pages. It may have done so, but it is strongly to be suspected that it did not. It will be observed, that the Editor of

the Chemist did not pretend to give any particulars as to the application of the power: and from this, it appears to us, he never had made any experiments on the "thought" he had "hit on," or had attempted in the smallest degree its practical application to machinery. Had he done so, however, imperfectly, he would, it is not to be doubted, have given something of the result of these experiments to the public; and it is strange he should have announced an original discovery to the world, without making a single experiment upon it. It appears to us he wishes it to be understood that the principle was taken by him from an instrument, an account of which is given in the same Number of the Chemist. The principle on which that instrument is constructed is, that by the voltaic battery a continued renewal of the electric current is presented; and in this instrument, this current of electricity gives continued motion to a brass ball suspended by a thread between two voltaic columns. This continued, we may say, perpetual motion, of the ball, he appears to wish it to be considered, excited the idea of applying Galvanism to obtaining mechanic power. It might certainly do this, but it never could have suggested the principle by which power is obtained in the discovery announced by him, which is very different, indeed, from the principle on which the toy is constructed. The principle of the new mechanic agent which he announces as his, but which we had given to the world not quite a month before, does not consist merely in creating motion by a continual current of electricity, which is the principle of the toy alluded to; and most assuredly if he thinks it does, he does *not properly* understand the principle of his own alleged discovery. The principle of that discovery, whoever may be entitled to the merit of it, is obtaining a power by decomposing water by means of electricity, and obtaining a vacuum by igniting the gases generated by the decomposition. His allusion to the motion generated by electricity in the toy, shows that he either did not understand the principle of his own discovery, if it be his, or that he wished, by that allusion, to conceal the source from whence the "*thought*" he had "*hit on*" was obtained. The discovery was announced in our Magazine in a very, indeed, in a rather too unobtrusive manner, and was too much mixed up with the details as to its application to propelling vessels in place of steam; and these things may have prevented many from noticing it at all. But it is quite unquestionable that our Correspondent was the first who discovered this new power; and there is strong reason to think that he is the only one entitled to the merit of the discovery. But we have thought it proper, both for his sake, and for our own, to enter thus minutely into his right to the honour of being the original and only discoverer of this power. After all that has been said about it, however, by the Editor of the Chemist, we strongly suspect that it will never be of such practical importance as he seems to think it will be. Our Correspondent, in his letter, seems to have doubts; but he had thought on it for years, he says; and had attempted, it would appear, its practical application; he therefore saw its disadvantages, although he might think they could possibly be got over. But it was a sudden thought with the Editor of the Chemist, and he therefore did not try it experimentally, and consequently could not appreciate its defects. We suspect it would be much too expensive ever to be of any practical use; but still we shall

be glad to hear that our ingenious Correspondent is proceeding with his experiment, and that he may yet be able to announce to the world that he has brought his invention to perfection.

CASE OF CROSS THE MECHANIC, AND HIS FAMILY.

We sincerely hope that the notice we have taken of this unfortunate man and his family, may yet turn out beneficial to the latter at any rate, although he is now beyond relief. We beg the attention of our Paisley friends to the following letter, and request those who can, will favour us with any information they may be possessed of on the subject: it will be an act of kindness to the orphan children, and may ultimately lead to their relief.

To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

SIR,—As you have on several occasions, in your valuable Mechanics' Magazine, humanely advocated the cause of the unfortunate and much injured Mr. James Cross, I think I am warranted in the liberty I now take of applying to you (as the best source of information,) for some farther particulars respecting that sadly neglected genius. His case has excited very considerable interest in this metropolis, and it is more than probable that it may lead to some active measures for the establishment of a security against the recurrence of so melancholy a tale, and of a means of encouraging and substantially rewarding humble talent wherever it may germinate. A few individuals here have it in contemplation to bring the subject before the public very shortly, and to seek a remedy for the evil, either legislative, or in the form of an association, adapted to the purpose; and to forward their benevolent views, are desirous of obtaining any information respecting the history of Mr. Cross, which you may have it in your power to furnish, farther than what has been already published in the Glasgow Mechanics' Magazine, particularly as to the present state of his orphan children, their number, ages, and in what way they may be at present provided for. But for your humane mention of the circumstances, and the circulation of your Magazine here, the miseries of the poor man would never have reached Southern ears; and, owing to your pre-supposing some knowledge of the individual, we are still but very partially acquainted with them.

As the plans in agitation are as yet but in embryo, I am not at liberty to say more respecting them at present, but I most fervently trust they will terminate advantageously to suffering talent; and if you would afford your kindly aid by complying with the above request, you would much oblige,

SIR, your obedient servant,

A. Z.

London, 22d December, 1824.

QUERY.

If it be true, as philosophers tell us, that it is owing to the porosity of bodies that they are transparent, how is it that some bodies comparatively opaque, (such as common writing paper,) become comparatively transparent by being laid over with oil?

J. B.

AN ACCOUNT OF THE GLASGOW GAS-WORKMEN'S INSTITUTION. By D. Bannatyne, Esq.

It is with the greatest pleasure we insert the following interesting account of the Gas-workmen's Institution; and we earnestly hope that the publicity thus given to it, will incite the proprietors of other large works to encourage similar plans of mutual instruction among their workmen. We have never seen nor heard of any plan more likely to improve the moral habits of the working classes, while it improves their mental capacity, than the plans here developed; and we, therefore, earnestly entreat the attention of our readers to Mr. Bannatyne's letter.

To the Proprietors of large Manufactories.

Gentlemen,—I take this mode of addressing you on a subject in which you are deeply interested, conceiving it to be the most likely channel through which the communication I have to make, may reach you generally.

I believe there is no difference of opinion now upon the question of giving education to the lower orders, or on the advantage of intellectual improvement, to persons in the humblest condition of life.—There has, in consequence, been, for some time, a general desire to afford to the people the means of instruction; and schools for teaching reading and writing, have been multiplied in every part of the country.

But, in merely teaching the people to read, we only open to them the door to knowledge; and, unless we can induce them to pass the portal, the stores which lie within will remain useless to them. The people of the different Asiatic nations have, for an unknown period of time, had the advantage of being taught to read; but their languages *supplying no* practically useful works, to which they could have access, no benefit has followed the attainment; and they have not advanced their own condition beyond what it appears to have been two thousand years ago, and have not been able to furnish one solitary contribution to those means which minister to human happiness and enjoyment.

The necessity, therefore, of doing something more than simply teaching the people to read, has not latterly escaped observation. Libraries, supported by subscriptions and donations, from the higher orders, have been formed in different places for the use of Mechanics and Artizans; and establishments for teaching them the branches of science, connected with their respective employments, upon the plan of the lectures given to Mechanics in the Andersonian Institution here, have been made in Edinburgh and London, and in several of our large manufacturing towns. All this is in excellent spirit, and calculated to do much good. But to make these measures effectually and permanently useful, I am satisfied, from the observation which I have had an opportunity of making, that these establishments, after they are once set a-going, ought to be supported and conducted, in a great measure, by the people themselves, in place of being managed, as is the case at present, by their superiors.

We have had sufficient experience of the progressive relaxation which takes place in the management of public institutions, by gratuitous Directors, from the higher classes, after the fervour which had set the machine in motion, has begun to subside; and the apathy with which the working people soon come to receive every thing that is done

by others for their benefit, is matter of daily complaint. But, on the other hand, wherever these same individuals can be led to consider the undertaking in which they are engaged as their own, its success never ceases to be an object of interest to them. The importance, too, which attaches to the management of such a trust, gives rise to honest feelings of self-respect, which, besides a value of perhaps still greater consideration, have their weight in keeping up the interest I have now mentioned.

These consequences which we see taking place in the opposite systems of management I have noticed, flow alike from principles inherent in our nature, and serve to indicate to us, that the more closely we can frame our measures for the people, in correspondence with their natural feelings, the more permanently successful they are likely to be.

I have considered it right to preface the communication I have to make to you, gentlemen, with these few general observations. I will now proceed to give you an account of a little institution, formed here, for the improvement of a single body of workmen; the history of which will show what is possible to be accomplished by each of you, in the business of education, independent of what may be effected by the greater general establishments for education, which I have taken the liberty of adverting to. If I am not mistaken, it will suggest plans for the instruction of the people, more efficacious, more easily executed, and more practically applicable to the end than any we are yet acquainted with.

The Gas Light Chartered Company of this city, in which I hold a considerable interest, and of whose Committee of Direction I have for some years been a member, employs constantly between sixty and seventy men in the works. Twelve of these are mechanics, and the others furnace men and common labourers of different descriptions; forming, altogether, a community, not very promising as a body to be incited to adopt measures for their own intellectual improvement.

A little more than three years ago, our Manager at the works, Mr. James B. Nelson, proposed to these men to contribute each a small sum monthly, to be laid out in books, to form a library for their common use. He informed them, that if they agreed to this, the Company would give them a room to keep the books in; which should be heated and lighted for them in winter; that in this room they might meet every evening, throughout the whole year, to read and converse, in place of going to the ale-house, as many of them had been in the practice of doing: That the Company would farther give them a present of five guineas to expend on books, and that the management of the funds, library, and every thing connected with the measure, should be entrusted to a Committee of themselves, to be named, and renewed by them at fixed periods.

With a good deal of persuasion, Mr. Nelson got 14 of the workmen to agree to the plan. A commencement was thus made. For the first two years, until it could be ascertained that the members would have a proper care of the books, it was agreed that they should not take them out of the reading-room, but that they should meet there every evening to peruse them. After this period, however, the members were allowed to take the books home; and last year they met only twice a-week at the reading-room to change them, and converse upon what they had been reading. The increase of the number of subscrib-

ers to the library was at first very slow; and at the end of the second year the whole did not amount to thirty. But from conversing with one another twice a week at the library, upon the acquisitions they had been making, a taste for science, and a desire for information, began to spread among them.

They had a little before this time got an Atlas, which, they say, led them to think of purchasing a pair of Globes. And one from among themselves, Alexander Anderson, by trade a joiner, who had had the advantage of attending two courses of the lectures in the Andersonian Institution, volunteered, about the beginning of last winter, to explain to them, on the Monday evenings, the use of the Globes. Finding himself succeed in doing this, he offered to give them, on the Thursday evenings, an account of some of the principles and processes in Mechanics and Chemistry, accompanied with a few experiments. This he effected with a simplicity of illustration and usefulness of purpose, that was delightful. He next, and while he was still going on with his lectures, undertook, along with another of the workmen, to attend in the reading-room, during the other evenings of the week, and teach such of the Members as chose it, Arithmetic.

For the business of this season, the Members of the Society, who conduct every thing themselves, have made a new arrangement.

The individuals of the Committee have come under an agreement, to give, in rotation, a lecture, either in Chemistry or Mechanics, every Thursday evening; taking Murray for their text book in the one, and Fergusson in the other. They intimate, a fortnight before, to the person whose turn it is, that he is to lecture from such a page to such a *page of one* of these authors. He has, in consequence, these fourteen days to make himself acquainted with his subject; and he is authorised to claim, during that period, the assistance of every Member of the Society, in preparing the chemical experiments, or making the little models of machines for illustrating his discourse.

It is a remarkable circumstance, in this unique process of instruction, that there has been no backwardness found on the part of any of the individuals to undertake to lecture in his turn, nor the slightest diffidence exhibited in the execution. This I can attribute only to its being set about without pretension or affectation of knowledge, and merely as a means of mutual improvement. And nothing, I conceive, could have been better devised for accomplishing this end. Indeed, I might with confidence say, that under this simple system of mutual instruction, which has grown out of the train of circumstances above mentioned, these persons, many of whom, when they joined the Society, were in a state of complete ignorance, have acquired a clearer idea and more perfect knowledge of the subjects which have been brought under their consideration, than would be found to have been attained by any similar number of students, who had been attending the courses of lectures given in the usual way by the most approved lecturers.

On the Monday evenings the Society has a voluntary lecture from any one of their number, who chooses to give notice of his intention, on either of the branches of science already mentioned, or upon any other useful subject he may propose. And there is, with the general body, the same simple, unhesitating frankness, and disposition to come forward in their turn, that exists among the Members of the

Committee, with regard to the lectures prescribed to them.

I think it will be interesting, and may not be without use, to mention particularly the subjects of the different lectures that have been given since this plan was adopted. They commenced in the month of September, and are as follows:

1st, Upon solidity, inactivity, mobility, divisibility.

2d, Attraction, cohesion, and repulsion.

3d, Attraction of gravitation.

4th, Centre of gravity, expansion of metals.

5th, Magnetism and electricity.

6th, Central forces. All motion naturally takes a rectilineal line.

7th, Mechanical powers.

8th, The lever, wheel, and axle.

9th, The pulley.

10th, The wedge and screw.

11th, Attraction of gravitation.

12th, Wheel carriages.

13th, The primitive form of chrystals.

14th, Hydrostatics.

The voluntary lectures began at the same time, and have been as follows:

1st, Upon the air pump.

2d, Electricity.

3d, An introduction to chemistry, principally to show chemical affinity.

4th, The properties of the atmosphere.

5th, The corn-mill.

6th, Coal mining.

7th, Practical observations on the blasting of whin rocks.

8th, Boring, sinking, and mining, and the properties of Sir Humphrey Davy's lamp.

9th, The globes.

10th, Do.

11th, Navigating a vessel from the Thames to the Orkney Isles.

12th, The nature of carbonic acid gas.

13th, A description of Captain Manby's invention for the preservation of shipwrecked seamen.

The effect of all that I have been relating, has been most beneficial to the general character and happiness of these individuals, and we may readily conceive what a valuable part of the community they are likely to become, and what the state of the whole of our manufacturing operatives would be, if the people employed in every large work were enabled to adopt similar measures. What might we not then be entitled to look for in useful inventions and discoveries, from minds awakened and invigorated, by the self-discipline which such a mode of instruction requires?

The Gas Light Company seeing the beneficial consequences resulting from the instruction of their work-people, have fitted up for them, this winter, a more commodious room to meet in for their lectures, with a small laboratory and workshop attached to it, where they can conduct their experiments, and prepare the models to be used in the lectures. The men, last year, made for themselves an air pump, and an electrifying machine, and some of them are now constantly engaged, during their spare hours, in the laboratory and workshop.

The whole workmen, with the exception of about fifteen, have become members of the Society, and these have been standing out upon the plea that they cannot read. They are chiefly men from the remote parts of the Highlands, or from Ireland. But the others say to them, join us, and we shall teach you to read: and I have no doubt of their persuading them to do so.

The rules of the Society, which have been framed by the Members themselves, are simple and judicious. Every person on becoming a member, pays 7s. 6d. of entry-money. This sum is taken from

him by instalments, and is paid back to him again should he leave the gas work, or to his family or heirs, should he die. Besides this entrance-money, each member contributes three half-pence weekly, two-thirds of which, by a rule made this year, go to the library, and one-third to the use of the laboratory and workshop. By a rule, made at the same time, which I think a curious indication of the change of feeling produced in these men in the short period since the commencement of the Society, the members may bring to the lectures any of their sons, who are above seven, and under 21 years of age.

The library now contains above three hundred volumes. These consist of elementary works of science, and books of history, voyages, travels, some of the standard poets, a few of our best novels, and Shakespeare's Works. The selection of the books, purchased by the library funds, is, in general, creditable to the Members of the Society.

They admit no books on religion into the library. The Members say that there are among them men of a variety of persuasions, Presbyterians, Seceders, Methodists, Church of England-men, and Catholics, each of whom would be for introducing books connected with their particular opinions, and thus give occasion to endless unprofitable disputes.

I hope you will agree with me, Gentlemen, in considering that there are valuable ideas on the subject of popular education, to be gathered from the little history I have just given. It appears to me that what has been so usefully done by the people at the Glasgow Gas Work, is capable of being effected, not only by the *workmen in every manufacturing establishment*, but in every part of *the country*, where a few persons *can be induced to form a Society* for mutual improvement. In places where there is a school-room, the use of it might be had for one or two evenings in the week, and the books might be kept in presses so placed as not to incommode the scholars. The School-master, too, might probably make a valuable member of the Committee. When assistance was wanted to procure these accommodations, the pecuniary contributions of the more wealthy persons of the neighbourhood for this end, would be doubly repaid to them in the improved character of all around them. The course of mutual instruction to be adopted in these little societies, might be varied to suit every pursuit in life, and each society, prosecuting inquiry in the direction of the particular occupation or business of its own members, would, while they were improving themselves, be in the most likely state to furnish valuable contributions to the stock of general knowledge.

Since writing the preceding, which was some weeks ago communicated by me in a letter to Dr. Birbeck, I have read the excellent article in the last number of the Edinburgh Review, on the scientific education of the people, and am happy to find the general views I had been led to form on this subject, from what I had had an opportunity of witnessing in the different establishments here, sanctioned and confirmed by the able and enlightened writer of this article. Indeed there is so much information collected in this article, on what has been done in different parts of the country, towards instructing the people, and so many suggestions with regard to what may yet be effected, that it is to be wished that it could be printed separately, in a cheap edition, and circulated in every quarter of the country.

DUGALD BANNATYNE.

Glasgow, 25th December, 1824.

REPORT

OF

Dr. URE'S LECTURE ON THE STEAM ENGINE,

IN AID OF THE FUNDS FOR ERECTING

A MONUMENT TO JAMES WATT.

On Monday evening, the 20th December, Dr. Ure delivered, in the hall of Anderson's Institution, the public Lecture on Steam, and the Steam Engine, which he had so kindly offered, in aid of the fund for erecting a Monument to the Memory of James Watt.

The sum collected amounted to about £54, a very large sum certainly, considering the size of the Lecture-Room. The Hall was crowded to overflowing at an early hour, and with a very brilliant and most respectable company. The Lord Provost, and several of the Magistrates and Ministers, with a great many Ladies of the first rank, were among the audience.

The well-known and highly appreciated literary and scientific abilities of the Professor, the greatness of the purpose for which the lecture was to be delivered, and the importance and value of the matters which it was to embrace, all gave reason to expect a treat of no ordinary kind; and assuredly that expectation was not disappointed. For, indeed, we never before heard so brilliant a display of scientific eloquence—never did we see science assume a form so attractive. The subject of the lecture was magnificent and important—its purpose not less so; and assuredly the Dr. did not appear for a moment to lose sight of this. The experimental illustrations exhibited, were splendid and successful; not less than five beautiful Steam Engines, of considerable power, were put into action, one after the other, and no pains were spared to make their structure, and their principle, evident to the audience.

The following, with which we have been favoured by a correspondent, will be found to be the most full and correct report which has yet been given to the public of this very interesting lecture:—

"The intellect of nations as well as of individuals has its periods of exertion and repose, of splendour and obscuration: thus the history of literature and of the fine arts is concentered round two epochs in ancient Greece, one in ancient Rome, and two or at most three in Modern Europe.

"The progress of science displays corresponding alternations of activity and quiescence; for illustrations of this truth we need hardly refer to the Ancient World. Its poets, orators, historians, and artists, indeed, have created such models as modern genius vainly strives to rival or even to imitate: but its philosophers discover on most occasions so little skill in scientific research—so little tact in interrogating nature, that they can be regarded merely as rude cultivators of that garden of knowledge which was destined in after ages to furnish perennial stores of fruit to delight the senses of man, and invigorate the frame of society.

"Little more than two centuries has elapsed since the human mind began on right principles to examine the system of the universe; to investigate rationally our terraqueous globe; to determine, by well devised experiments, the mutual actions of matter; and, from a comparison of the whole phenomena, to deduce results capable of enlarging the empire of man over nature, and of qualifying him to accomplish the mandate of his Maker, to subdue the earth, in order to enjoy the admirable bounties of Providence.

"Galileo then appeared—the noble Florentine. He constitutes the focus round which the first bright rays of practical science were converged, and from which they became diffused among the nations.

"By investigating the laws of motion, he laid the foundation of practical mechanics, and applied his valuable deductions to the operation of machines, as well as to the celestial movements. He also suggested the first ideas concerning the pressure and equilibrium of the atmosphere.

"Such was the dawn of that practical philosophy which now in rich effulgence illuminates the arts of Britain.

"What honours and rewards were bestowed on the man who first shed these rays of awakening light on a world lying in darkness? For demonstrating the true constitution of our solar system—the daily rotation of the earth on its axis, and its annual revolution round the central sun—the rugged mountainous structure of our moon and the satelites of Jupiter, besides many other equally important truths which your time will not permit me to recount, Galileo was vilified as an impostor and a heretic, hunted from one Italian principality

to another, finally apprehended as a culprit, compelled to kneel before a conclave of ignorant cardinals, and condemned to perpetual imprisonment. Such was the fate of the greatest philosopher—the most elegant writer and accomplished gentleman which his country has produced.

"In 1642, the year in which death relieved Galileo from his priestly persecutors, Providence called another mind into being, which was ordained to confirm beyond dispute, and to extend to universal nature, the primary deductions of the Florentine. This was Isaac Newton; a man, by the consent of all nations, placed at the head of his species—the noblest representative of human reason. In his presence, Satraps and Sultans, Emperors and Autocrats, hide their diminished heads. As Galileo had been the source of emulation among his contemporaries, so Newton became the philosophic sun, round which a hundred scientific satellites, in the various kingdoms of Europe revolved, and from which they borrowed their illumination. The conclusion of the 17th century constitutes therefore the second splendid era of true science, as its commencement had been the first. But dazzled by the blaze of Newton's discoveries, mankind seemed to lose for a season the faculty of making spontaneous researches into the different regions of nature. Accordingly, a period of quiescence, nearly equal to the former, now intervenes, during which science is seen to repose on her laurels.

"But too mighty and general an impulsion had been given to human reason, for it to subside into apathy and inaction. And soon a third and most magnificent era commenced; for a new world, abounding with productions, powers, and privileges, incalculably extensive and beneficial, began to be explored and conquered by science. This was the invisible and intangible world of elastic fluids; but not on that account either a shadowy or unsubstantial realm. Now the wild spirits of the Alchemists were tamed; their incoercible vapours were taught docility and restraint. Here actual scenes burst upon our view, more marvellous than any pictured in the pages of oriental romance. The first Arabian Alchemists believed that the elements were under the dominion of intelligent spirits, who might be brought into subjection to human power; and the fantastic tales of fairies and genii, narrated with such a luxuriance of fancy in the Thousand and One Nights, formed the creed of those mystical adepts. But modern science disdains to cherish such chimeras. It perceives, and solemnly acknowledges, one creative and superintending mind, which has formed every part of the material system in truth, harmony, and beneficence; and which has conferred on man the glorious privilege of searching out the principles of elemental change, so as to direct them at his will, and with a surer aim than superstition ever could dare to suppose her supernatural phantoms possessed.

"Alladdin's fabled lamp, which enabled its bearer to explore the hidden treasures of the earth, to wander unhurt amid malignant demons, and to return to the surface laden with spoil, is more than realized by Sir H. Davy's wondrous invention. The winged horse is but a feeble representative of the aerostatic machine, by whose buoyancy man may rise to elevations above the eagle's flight; and the enchanted boat, which glided against the current, and the breeze, is far surpassed by our actual steam-ship, the modern leviathan, which, instinct with fire, marches over the mountain wave, and bids defiance to the storm." *(Here the applause became enthusiastic.)*

The Professor, after adverting to the discoveries of Franklin, Black, Watt, and Cavendish, which render the middle and latter part of the last century so illustrious an epoch in the history of the human mind, proceeded to exhibit experiments explanatory of the nature of elastic fluids and vapours. A beautiful display was made with Davy's lamp, placed in a great glass receiver filled with explosive gasses. The cage of the lamp was filled with flame, and its wire-cloth became red hot, without the least tendency to explode in the surrounding body of gas. The illustrations given of the production and properties of steam, subservient to the construction of the steam-engine of Watt, were also very pleasing and conclusive.—The engine models were next set a-going; first Savery's, made by those very ingenious gentlemen, Messrs. Hart; 2d, Newcomen's, made by Mr. Condie; 3d, Watt's, with conical valves (an admirable model, made by Mr. Cook); 4th, the section-model of Watt's sliding valve engine; and lastly, the loco-motive; the latter two being also made by Mr. Condie. The loco-motive travelled at a very rapid rate, performing its circular evolutions with astonishing power and precision.

"It is ascertained, that the WORK NOW PERFORMED by the STEAM ENGINE of WATT in Great Britain, is equivalent to the labour of about HALF A MILLION of stout horses—but the horses require relays in order to continue the work, and therefore at least *double* the number would be required in the course

of 12 hours, forming the amazing aggregate of ONE MILLION, equal to the labour of FIVE MILLIONS OF MEN.

"The volume or bulk of the great pyramid of Egypt is equal to nearly 5,333,333 cubic yards, and the weight of one cubic yard of its material being about 2 tons, its whole weight is 10,666,666 tons. The centre of gravity of the pyramid stands 54 yards above its base, and taking 12 yards as the average depth of the quarries from which the stones were raised, we have for the total altitude of that centre 66 yards, which multiplied by 10,666,666, give about 704 millions of tons, elevated one yard high.

"Now the British steam-engines represent a power of 500,000 horses; THESE MACHINES moving for 24 HOURS, can raise 3420 MILLIONS OF TONS one yard high, taking Watt's estimate of 32,000 lbs. one foot high in a minute for a single horse power, consequently they could raise 704 millions of tons being the equivalent WEIGHT OF THE PYRAMID, in less than FIVE HOURS.

"M. Dupin, three years ago, astonished the institute of France, by showing that the British engines could raise all the stones of the pyramid from the quarries into their respective places by 18 hours work, but he must have greatly under-rated the power of the steam engine, even allowing for their rapid increase since that time. Herodotus tells us, that the great pyramid employed in its building the whole available population of Egypt for 20 years; CHEOPS, the king, was so detested for imposing this grinding labour on his subjects, which totally impoverished the country, that they suffered neither his own bones nor those of his posterity to repose in this absurd mausoleum. Now mark the difference between ancient and modern industry—between that of slaves and of freemen. All the labour of Watt's engines is employed in productive operations, nourishing the people, and enriching the state to a degree which it is not easy to imagine or compute.

"At the period when James Watt rendered his engine applicable to every purpose of art, he made a present to his country of a power more economical, more disposable, more stupendous, and more essential, than all the other powers previously applied to manufactures.

"He has enabled us to descend to prodigious depths in the earth, formerly inaccessible: and has created there provinces of subterranean wealth, infinitely more important and valuable than all our colonies in East and Western Ind; provinces which the chances of war can never wrest from us; and which require no mighty military array to secure. And all this has been done with a little fuel, which he himself supplies, a little water, a cylinder, a piston, and a few levers. How truly did Bacon declare, 'knowledge is power'! The knowledge of the laws of nature arms our feeble hands with her most gigantic forces! How many populous and flourishing cities and towns have been created by the genius of Watt! What were Birmingham, Manchester, Nottingham, Leeds, Preston, Glasgow, and many others, before his engine gave them vitality? and what would become of them were it to disappear? What, in this case, would feed our multiplied population, what would pay the interest of our national debt, where would be the pre-eminence of Britain? Deprived of the boundless resources furnished by Watt, no Nelson could have been sent forth to sweep the ocean, for the meteor flag of England would, but for his vestal fire, long ere now have ceased to burn; and the three hundred millions expended in the Peninsular war was the produce of the alchemy of Watt.

"But what new phenomenon do we behold! Mark that mighty vessel issuing from the port! She bears her gallant prow through the opposing billows. She braves alike 'the battle and the breeze.' In vain does the rage of man try to stem her triumphant course; in vain do the elements resist her career. See she marshals the English fleet; she plants the mighty war ships in their station, while their sails are furled in the calm. She manœuvres them so as to baffle and surround the foes. They are conquered, but flight is no longer possible. The genius of Watt arrests them, as if by an irresistible spell. Then wars shall cease, because resistance shall be hopeless,

'——Then hostile fraud shall fail,
'And white-rob'd justice lift her golden scale.'

(Great applause.)

"Milton's bold fiction of chariots moving by vital impulse is realized in the locomotive engine—

'Chariots winged, harness'd at hand,
'Celestial equipage—and now came forth
'Spontaneous, for within the spirit lived.'

"The time is not far distant when chariots winged with fire shall be seen flying over metallic pavements through all the populous districts of the empire, transporting travellers and merchandise with amazing smoothness and velocity.

"From these marvellous effects shall we remount to causes? Shall we trace the early development of this master-mind, this true philosopher, this tutelary genius of Britain, who has done for the earth what Newton did for the Heavens—teaching us to explore its regions of land, water, and air, and to apply their productions to the uses of life." Here Dr. Ure gave an account of Mr. Watt's early education, which was by no means neglected either on his own part or that of his very respectable parents. "At 21 years of age, he commenced business as a Mathematical instrument maker in Glasgow, where he found congenial minds and zealous patrons in the celebrated men who then adorned our University. At that time Mathematics, the foundation of all the exact sciences, flourished here, for Robert Simpson was the teacher, a name which awakens many mingled emotions. Then Adam Smith, previously trained to habits of accurate thinking by the study of geometry and astronomy, shed the kindred glories of literature and science around him; and Black was ardently opening his auspicious career of discovery. When will such a triumvirate again appear to cherish the nascent genius of another Watt!" The Professor, after detailing minutely the various improvements of Mr. Watt upon the steam engine, and the experiments he made in their prosecution, read some extracts from Mr. Watt's patent, which clearly showed that all the later varieties of the steam engine were anticipated and described minutely by that philosopher; he then concluded nearly as follows:—

"Nothing could be happier than the moral constitution of Mr. Watt's mind. Ardent in research, yet patient of disappointment; bold in his general views, gentle but firm in carrying them into effect, bland in the intercourse of social life, yet not without the raciness of genius, which gave an original zest to all he said, and rendered every casual companion his friend and admirer. There was but one thing which his soul seemed to loathe, and which called forth its latent artillery of sarcasm, and that was illiterate presumption.

"In the summer of 1805, I had the honour of spending two days with him at his villa of Heathfield, near Soho, on my return from a scientific tour through England. Many doubts and difficulties had occured to me, some of which I ventured to state to Mr. Watt. Then the spring of knowledge flowed forth in a most refreshing stream, and wherever it turned flowers and fruits came up spontaneous. To every topic he gave singular interest, by the originality and justness of his views. His intellectual alembic had sublimed from every subject its purer essence, and left the grosser parts behind. Hence his memory, though vastly capacious aud retentive, never betrayed the recollection of any thing dull or common-place. Its compartments were all distinctly defined, and each was replenished with its peculiar store of intellectual wealth. Intense study is apt to engender grave and even recluse habits, as is seen in the biography of Newton, and many other illustrious philosophers. It may be doubted, therefore, if ever there existed so happily framed a mind as that of James Watt; which, deep and powerful like the ocean, could, in society, assume the sparkling vivacity and innocent playfulness of the crystal rill. This is the perfection of philosophy. Thus knowledge becomes truly amiable; and, pursued in the spirit of Watt, it is calculated to render us dear to our friends, valuable to our country, and humble in the sight of God. Mr. Watt's piety was rational, steady, and unobtrusive. His benevolence discovered itself in every circumstance of his life, for he sought to do good to the extent of his power, being a perfect stranger to envy and every malignant feeling. And, after a life so eminently useful, he surrendered his soul, in the utmost tranquility, to that Supreme Intelligence which had, for 84 years, made him its peculiar care."

NOTICES TO CORRESPONDENTS.

G. M. will find a letter for him at our Publisher's.—C. N. writes cleverly and smartly, although on a *man* we too much despise to notice in our pages.—Communications received from Dixon Vallance and S. C.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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MECHANICS' MAGAZINE,
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

.................." I will have none on't:
We shall all be turned to barnacles, or to apes
With foreheads villainous low."—*Shakespeare.*

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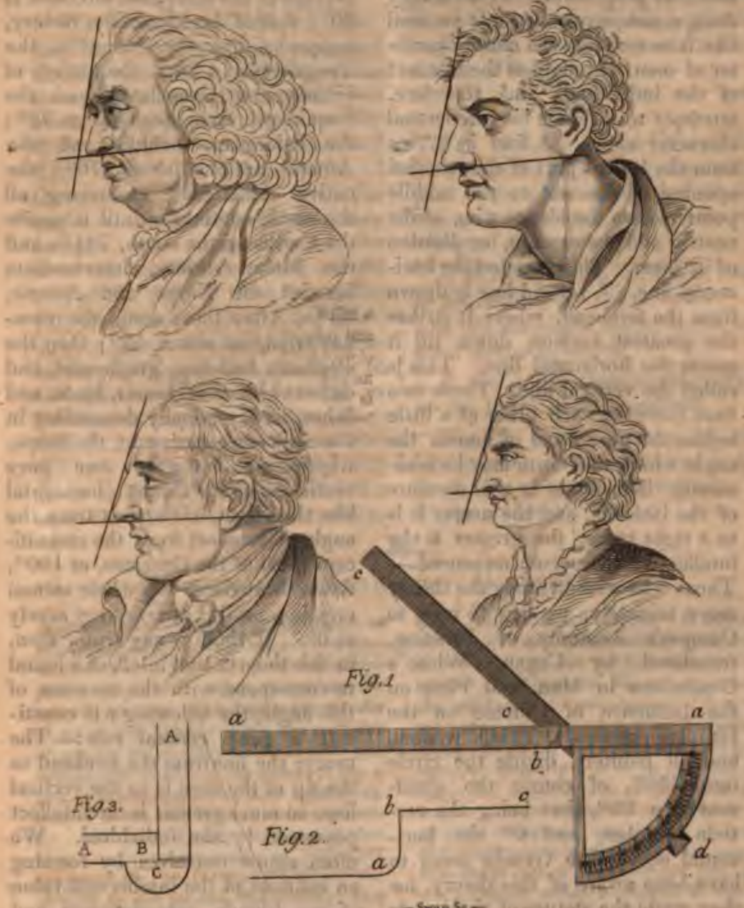
THE FACIAL ANGLE.



ON THE FACIAL ANGLE.

When Phrenology is exciting an interest so very general, we think a short account of the theory of the facial angle of Camper may not be uninteresting. This theory receives at present considerable attention from the learned world; and, indeed, extensive and accurate observations seem to confirm it. It takes no cognizance of the sentiments or propensities as Phrenology does, consequently does not pretend like it to estimate the moral character of man, it judges of the intellect of the individual; and, therefore, attempts to estimate his intellectual character alone. A line is drawn from the lowest part of the external opening of the ear to the middle point, where the ala, or wing of the nostril, and the septum, or division of it, meet. This is called the horizontal line. A second line is drawn from the forehead, where it strikes the greatest surface, down till it meets the horizontal line. This is called the vertical line. These two lines intersect each other at a little before the nose; and of course the angle which they form may be measured. This angle is the measure of the intellect, and the nearer it is to a right angle, the greater is the intellect of the person measured.—Those who wish to study the theory more minutely, we beg to refer to Camper's Anatomy of Painting, translated by Cogan, White's Gradations in Man, and Pitta on the Influence of Climate on the Human Species. These writers, and all painters, divide the circle into 360°, of course the quadrant into 90°, that being the verticle number, and 0° the horizontal one. The Greeks seem to have been aware of this theory, for they made the statues of their gods and of their heroes 100°. If the angle measures more than this, it is deformity; and if it is below 60°, which very rarely happens, it is equally a deformity, and must be accompanied with great want of intellect. It is not uninteresting to trace the measure of this angle from the ideal forehead of the Greek sculptors, to the lower animals, through all the many gradations we meet with in the descent. The average of the European forehead is 80°; that of the Mongolian variety, comprehending the Calmucks, the Tungooses of China, the natives of Siberia and Greenland, and the Esquimaux, from about 72° to 78°; the Ethiopian, including all the African nations, about 70°; the native Americans, embracing all the north continents until it meets the Caribs on the south, 73½°; and the Malay variety, intermediate betwixt the Negro and Asiatic, 75°. After these come the monkey tribe, at about 42°; then the elephant, bull-dog, greyhound, and different kinds of beasts, birds, and fishes, until gradually descending in the scale, we arrive at the snipe, where we find the line once verticle, now almost horizontal like the other. We thus trace the angle of intellect from the magnificent ideal of the Grecians, at 100°, down throughout the whole animal creation, until it arrives very nearly at 0°. If there is any truth, then, in this theory, that intellect is found to correspond with the measure of this angle, the following will constitute a good general rule:—The nearer the line from the forehead to the tip of the nose is to the vertical line, so much greater is the intellect possessed by the individual. We often amuse ourselves by forming an estimate of the intellectual value of our friends, acquaintances, and those we meet in company, by the application of this rule; and indeed

it is surprising how quickly, and with how much accuracy practice enables us to judge of the extent of the angle, merely with our eye, making ideal lines on the countenance of the person we examine.—Any one may soon do this, and thus compare together the talents of his several friends; or he may compare the watch-dog of known sagacity, to the greyhound which knows nothing but the chase.

We have given heads of Newton, Lord Byron, Dr. Johnson, and John Kemble, and have drawn the lines and formed the angles upon them, in order to illustrate the theory of which we have attempted thus to give an account. In all these faces, it will be seen, the angle is much above the ordinary average, and approaches to the ideal of the Greeks; and, should any of our readers want to see the very antipodes of these, they have only to search their pockets for one of the old pennies of the reign of George the Third, and there, in the head of the good old King, they will find an angle far below the ordinary average, seemingly not above 50°. We wonder who the artist was, that thus, with impunity, was allowed to libel and misrepresent majesty. He must have had a rather singular conception of beauty or dignity in the human countenance, who gave such a forehead to a human head. Had we been Master of the Mint at the time, we never could have forgiven ourselves for allowing such a misrepresentation to go abroad to the world.

We have also subjoined an engraving of a faciometer, by which those who wish to be particular may more exactly measure the intellect of their friends.

S.

Fig. 1. *a*, the upper part of the blade, to be applied to the under part of the external opening of the ear, and the lowest part of the division of the nose.

b, A small curve, to adapt itself to the turn of the cheek-bone.

c, the moveable blade, to be applied to the forehead.

d, the point showing the angle on the index of the quadrant.

Fig. 2. Profile of one of the blades, showing the curve at *b*, fig. 1. A, the greatest turn required. B C, the quadrant.

ON THE DIVISIBILITY OF MATTER.

MATTER possesses another property, or primary quality, called impenetrability, or resistance. It is this property which prevents one body from occupying the space of another. It is a property equally of solids and fluids. Now, the particles of matter we must conceive as also possessing this quality of resistance; for, if not, it is not easy to see how a combination of them, in any body, could possess it: Further, if they have resistance, they must also have extension, and must, consequently, be further divisible; for, if they do not possess this quality, they are, in our conceptions, at least, mere nonentities, or else mere space; from which it would follow, that all matter is space, and all space, matter. It is true, that we are not sensible of the resistance of the air in which we breathe, neither are the inhabitants of the sea sensible of the resistance of their element. But we are not to conclude from these facts, that either the one or the other does not possess this property. For as soon as we leave our element and plunge into the water, we are immediately sensible of its great resistance; and, in like manner, it is most probable, that when an animal is brought out of that element into the air, a similar resistance should be felt on its part. The conclusion we draw from this is, that even the particles of these subtle fluids must possess this quality,

and consequently extension and further divisibility. Locke, in another passage, asserts this opinion very pointedly, thus: "A pestle and mortar will as soon bring any particle of matter to Indivisibility, as the acutest thought of a mathematician; and a surveyor may as soon, with his chain, measure out infinite space, as a philosopher, by the quickest flight of mind, reach it, or, by thinking, comprehend it. He that thinks on a cube of an inch diameter, has a clear and positive idea of it in his mind, and so can frame one of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, and so on, till he has the idea in his thoughts of something very little; but yet reaches not the idea of that incomprehensible littleness which division can produce. What remains of smallness, is as far from his thoughts as when he first began; and, therefore, he never comes at all to have a clear and positive idea of that smallness which is consequent to infinite divisibility." A third quality of matter that seems to be manifestly primary, is position; that is, its occupation of space either in motion or rest. We cannot conceive of any portion of matter in existence, without some position, situation, or place, which it occupies. Now, if the particles of matter are different from space, and possess the quality of extension, they must occupy some portion of space, however small, either at rest or in motion. If the space they occupy be divisible, it must follow that they themselves are also divisible, otherwise they do not completely occupy the space which they do occupy. If it be said, that no body completly occupies space, because the hardest body we know is porous; still, we must conceive these pores to be filled with particles of air, or something else. And, besides, the particles of the body itself that are not porous, or which give existence to the pores, must completely fill up their space, else bodies would be all pores or all space together, and, consequently, there would be no matter at all. And if this cannot be admitted, then we must conceive these particles capable of farther subdivision, as long as the space they occupy exists, or as long as they exist themselves and fill up space. Now, the parts of these particles occupy a space less than the particles themselves; and these particles again a still smaller space, &c. *ad infinitum*. If these particles, which are thus supposed to be continually becoming less and less, be matter, we cannot deny their continued divisibility. For if it be supposed that the division would terminate at any point, that point would not be matter, else we must conceive it to be further divisible; because, if we deny this, we must deny every one of the preceding steps in this division, till, at last, we should deny the divisibility of matter at all. No person, for instance, could suppose that the half of an apple would be any way different from the millionth part of it, except in size; what might then be conceived as the ultimate particles of the apple, could not be any otherwise different; and if not, they must be conceived as capable of further subdivision without end. As Mr. Locke says, "Divide matter into as minute parts as you will, which we are apt to imagine a sort of spiritualizing, or making a thinking thing of it, vary the figure and motion of it as much as you please, a globe, cube, cone, prism, &c., whose diameters are but a millionth part of a gry, (which he calls a thousandth part of a philosophical foot,) will operate no otherwise upon other bodies of proportionable bulk, than those of an inch or foot diameter." To illustrate the divisibility, we shall suppose the following example. If a vessel of any kind was filled with an equal quantity of milk and water, a mixture would take place, and the particles of the milk would be visibly diffused through the water. Then suppose the half of this mixture poured out, and the vessel refilled with water, a second mixture would take place containing less of the milky particles than the former, but still visible. Now, let us suppose this process to be continued for ever, I imagine we could not affirm, at any period of this process, though never so distant from the time it was begun, that not a single particle of milk remained in the vessel, although not visible to the naked eye, or even when aided by the most powerful microscope. For, if we were to affirm this at any period, we must also affirm it of each of the preceding steps, till we should finally assert that there were no particles of milk in the vessel at first, which would be absurd. Therefore, Q. E. D. that these qualities of matter we have considered, prove its infinite divisibility, is supported by Locke, in the following passage, on the primary qualities. "Take," says he, "a grain of wheat, divide it into two parts, each part has still solidity, extension, figure, and mobility; divide it again, and it still retains the same qualities; and so

divide it on, till the parts become insensible, they must retain still each of them all those qualities. For division can *never* take either solidity, extension, &c. from any body, but only make two or more distinct separate masses of matter of that which was but one before." It may here be observed, that the qualities which Locke reckons primary, are solidity, extension, figure, motion, rest, number. Now, it is obvious, that solidity, as well as fluidity, are but modifications of resistance, figure and number of extension, motion and rest of position, or occupation of space.

We shall close this part of the subject in the words of the celebrated Burke, in his inquiry on the sublime and beautiful. "When we attend," says he, "to the infinite divisibility of matter; when we pursue animal life into these excessively small, and yet organized beings, that escape the nicest inquisition of the sense; when we push our discoveries yet downward, and consider those creatures so many degrees yet smaller, and the still diminishing scale of existence, in tracing which, the imagination is lost, as well as the sense, we become amazed and confounded at the wonders of minuteness; nor can we distinguish in its effect this extreme of littleness from the vast itself; for division must be infinite, as well as addition; because the idea of a perfect unity can no more be arrived at, than that of a complete whole, to which nothing may be added."

(To be continued.)

ON WATT'S MONUMENT.

Mr. Editor,—I am in use to take out your excellent Magazine in monthly parts, and hence, till last night, had not seen an article subscribed W. G. in your Number of 4th December, entitled, "Monument to James Watt." There is an invidious statement made in the close of that paper which I cannot permit to remain uncontradicted. The writer lauds Professor Anderson, and has assigned him even a higher niche than the illustrious Watt; for he discovers that it is to the Professor, not to the Mechanic, belongs the merit of the improvements in the Steam Engine. "Had not *our* venerable founder," writes W. G. "Professor Anderson, required his (Watt's) assistance, in a very small matter, the Steam Engine of Watt, and the consequent wealth and prosperity of our country, as well as the glory of this day, *would never have had an existence.*" I leave this very erudite conclusion to the Committees for the erection of Watt's Monument, who had better pause ere they erect a monument merely to a subaltern. The passage, with which I have more especially to do is further on, and runs in the following terms: "It is also worthy of remark, that this very Institution was, by the will of its founder, established for the benefit of the Manufacturers and Artizans of Glasgow, so that to Professor Anderson may be traced the origin of all those Mechanic Institutions, which have since arisen in Britain, *an honour which has hitherto been ascribed to another individual.*" Well, how foolish have the world been, and how culpable W. G. to keep the secret so long *confined to his own* breast! The world have "*hitherto*" imagined Watt to be the improver of the Steam Engine, and Dr. Birkbeck the founder of Schools, for the education of Mechanics. But "*henceforth*," on the showing of W. G., the "distinguished and undisputed honour" must be awarded to Professor Anderson. I hate controversy much, but I hate injustice still more, and will not see Dr. Birkbeck (the "*individual*" alluded to, had W. G. chosen to speak out,) thus gratuitously stripped of his well merited honours. If Professor Anderson be indeed the founder of Mechanics' Institutions, I do call on W. G. as he respects truth and his own character, to give the public the clause in his Will, which can be tortured into such a construction; and I ask W. G. to explain how the plan, if it did exist, was delayed, until carried into effect by Dr. Birkbeck. The proof, let it be observed, rests with W. G., and if the Will did contemplate this species of instruction, it will be matter of easy solution.

While I do insist, that with your Correspondent, rests the burden of proof, yet I am inclined to mention a fact or two, on authorities which I know W. G. will not be induced to impugn, which will clearly demonstrate with whom the disputed merit rests. These facts can be attested by hundreds. If they were known to W. G. then his conduct was improper. If unknown, it was rash and imprudent. It is now two winters ago, when, after the ordinary lecture of Dr. Ure to the Mechanics' Class, two aged Mechanics requested to be heard by the Class; and they then read to the

Class a statement of facts connected with the institution of that Class, wherein they assigned the whole merit to Dr. Birkbeck. One of these Mechanics was named Black. I regret that at the present moment I do not recollect the other name. On this occasion, a highly talented Member, (Mr. Dykes,) with that caution and good sense which ever distinguished him, suggested the expediency of first inquiring what share Professor Anderson had in the Institution of the Mechanics' Class, previous to taking any step to fix the projection with Dr. Birkbeck. This prudent suggestion was acceded to, and a Committee named, whereof Dr. Ure very handsomely consented to be a Member. On a subsequent evening, two of the Committee appeared, (Messrs. Hart and Watt,) and read an extract of Professor Anderson's will. I have never seen this will, and merely speak of its terms from memory. It seemed dictated under a pique to the University, and its design to have been the rearing a rival College. Thirty Professors, if I recollect well, were to be appointed, under the superintendence of an extensive and influential board of management, taken from certain most fanciful divisions of the community. The whole was every way at variance with the principles of Mechanics' Institutions. No provisions were made as to economy of education, the chief feature of Mechanics' Institutions. The words "Manufacturer and Artizan," alluded to by W. G. were also commented on, *but the Class agreed with the Committee, that nothing in the Will gave the slightest countenance to the notion that Professor Anderson had contemplated the Mechanics' Class.* On a following evening, Dr. Ure, himself, very kindly produced the Sederunt Book of the Managers, *and, from it, declared his conviction, that the merit rested solely with Dr. Birkbeck.* Accordingly, an Address was voted to Dr. Birkbeck, and subscribed by the Classes. This Address was originally penned by Dr. Ure, and directly stated Dr. B. to be the first who opened the portals of Science to the Operative Mechanic.

I could add some more minute details, tending to the same conclusion. I have been special in what I have said, to afford W. G. or his friends, an opportunity of making themselves acquainted with the accuracy of my statements.

B.

Glasgow, 28th Dec. 1824.

P. S. In allusion to a note in the Magazine before last, I owe it in justice to myself, and to the memory of Professor Anderson, to declare, that it is far indeed from my wish to throw the slightest obloquy over the memory of that admittedly illustrious philosopher. Yet it is neither respect to the feelings of the living, nor reverence for the memory of the departed, which should restrain the free declaration of truth; and if the truth be unpalateable to some, it is those who seek unjustly to deck the tomb of the dead with the laurels of the living, not those who wish to place the honour where it ought, who are to blame.

ON THE MODE OF TRACKING ON CANALS.

An Edinburgh Correspondent states that in his opinion great improvements might be made on the manner in which the boats are dragged on canals. The present oblique manner in which the horses are harnessed to the boats, is attended, he thinks, with a great loss of power, and with much risk and danger to the poor animals employed. We are of the same opinion; and, when we see daily the greater portion of the horses' strength exerted in keeping themselves out of the water, and in opposing the power of the helm, we have been often surprised that no attempt was ever made to remedy the defect. The horses ought clearly to go in a line parallel to the boat; and this would be most useful to the passage boats, as they would then be able to go much quicker, and with more ease than they at present do. Our Correspondent proposes that a beam should be fixed to the boat as near the centre of motion as possible, with a guy rope fastened to the stern of the boat, and that to the outer end of this beam the horses should be harnessed: he thinks that were such a plan adopted, two horses could do more work, and with more ease and safety, than three can by the present mode.

THE CHRISTIAN PHILOSOPHER; OR, THE CONNECTION OF SCIENCE AND PHILOSOPHY WITH RELIGION.

By Thomas Dick.

The Second Edition, Enlarged.—Glasgow: Chalmers and Collins.—1824.

Science, when prosecuted with unbiased feelings, and that philosophic calmness and humility of mind which it is so well calculated to produce, must always tend to strengthen and confirm the religious belief of those who walk in its delightful paths. It exhibits such wonderful instances of the grandeur of God's wisdom; such magnificent examples of his goodness and benignity to man, that it may well fill the heart with the strongest feelings of veneration, gratitude, and joy. But unfortunately science has not always this effect. Man, proud of his knowledge and his wisdom, too often disregards the great cause of the wonders he beholds; and admires more his own skill in developing and explaining the laws of nature than the wisdom of God, from whom they emanated. It is very pleasant, therefore, to see in such a book as this, science and philosophy connected with religion; and the author assuredly deserves, and most undoubtedly will receive, the thanks of all good men for the work which he has so well executed. We on a former occasion, in our Twelfth Number, noticed the publication of this work, and gave an abstract of its contents, with some quotations, to which notice we refer our readers. We are very happy to see that a second edition has been called for, and are no less so to perceive that this edition has issued from the Glasgow press. Glasgow has done much to connect philosophy and science with the Arts; and it is well for her also to show that she can connect them with religion likewise. The work has had many additions made to it, and a considerable part of it has been re-written, so that it is now rendered even more valuable than it formerly was. Some of the author's speculations, though they may appear fanciful to a few, are curious and interesting. We extract the following on Acoustic Tunnels:—

Acoustic Tunnels.—By means of the inventions just now adverted to, when brought to perfection, mankind may be enabled to transport themselves to every region of the globe, with a much greater degree of rapidity than has hitherto been attained. By the help of the microscope, we are enabled to contemplate the invisible worlds of life, and by the telescope we can penetrate into regions far beyond the range of the unassisted eye. By the arts of Writing and Printing we can communicate our sentiments, after a certain lapse of time, to every quarter of the world. In the progress of human knowledge and improvement, it would obviously be of considerable importance, *could we extend the range of the human voice*, and communicate intelligence to the distance of a thousand miles, in the course of two or three hours; or could we hold an occasional conversation with a friend at the distance of 20 or 30 miles. From experiments which have been lately made, in reference to the conveyance of sound, we have some reason to believe, that such objects may not be altogether unattainable. It has been long known, that wood is a good conductor of sound. If a watch be laid on the one end of a long beam of timber, its beating will be distinctly heard, on applying the ear to the other end, though it could not be heard at the same distance through the air. In "Nicholson's Philosophical Journal," for February 1803, Mr. E. Walker describes a simple apparatus, connected with a speaking trumpet, by means of which, at the distance of 17½ feet, he held a conversation with another, in whispers too low to be heard through the air at that distance. When the ear was placed in a certain position, the

words were heard as if they had been spoken by an invisible being within the trumpet. And what rendered the deception still more pleasing, the words were more distinct, softer, and more musical, than if they had been spoken through the air.

About the year 1750, a merchant of Cleves, named Jorrissen, who had become almost totally deaf, sitting one day near a harpischord, while some one was playing, and having also a tobacco-pipe in his mouth, the bowl of which rested accidentally against the body of the instrument, he was agreeably and unexpectedly surprised to hear all the notes in the most distinct manner. By a little reflection and practice, he again obtained the use of this valuable sense; for he soon learned, by means of a piece of hard wood, one end of which he placed against his teeth, while another person placed the other end on his teeth, to keep up a conversation, and to be able to understand the least whisper. In this way, two persons who have stopped their ears may converse with each other, when they hold a long stick or a series of sticks, between their teeth, or rest their teeth against them. The effect is the same, if the person who speaks rest the stick against his throat, or his breast, or when one rests the stick which he holds in his teeth against some vessel into which the other speaks; and the effect will be the greater, the more the vessel is capable of tremulous motion. These experiments demonstrate the facility with which the softest whispers may be transmitted.—Water, too, is found to be a good conducter of sound. Dr. Franklin assures us, that he has heard under water, at the distance of half a mile, the sound of two stones struck against each other. It has also been observed, that the *velocity* of sound is much greater in solid bodies than in the air. By a series of experiments, instituted for the purpose of determining this point, Mr. Chladni found that the velocity of sound, in certain solid bodies, is 16 or 17 times as great as in air.

But what has a more particular bearing on the object hinted at above, is, the experiments lately made by M. Biot, "On the transmission of sound through solid bodies, and through air, in very long tubes." These experiments were made by means of long cylindrical pipes, which were constructing for conduits and aqueducts to embellish the city of Paris. With regard to the *velocity* of sound, it was ascertained, that "its transmission through cast iron is 10½ times as quick as through air." The pipes by which he wished to ascertain at what distance sounds are audible, were 1,039 yards, or nearly 5 furlongs in length. M. Biot was stationed at the one end of this series of pipes, and Mr. Martin, a gentleman who assisted in the experiments, at the other. They heard the lowest voice, so as perfectly to distinguish the words, and to keep up a conversation on all the subjects of the experiments. "I wished," says M. Biot, "to determine the point at which the human voice ceases to be audible, but could not accomplish it: words spoken as low as when we whisper a secret in another's ear were heard and understood; so that not to be heard there was but one resource, that of not speaking at all.—This mode of conversing with an invisible neighbour, is so singular, that we cannot help being surprised, even though acquainted with the cause. Between a question and answer the interval was not greater than was necessary for the transmission of sound. For Mr. Martin and me, at the distance of 1039 yards, this time, was about 5½ seconds." Reports of a pistol fired at one end occasioned a considerable explosion at the other. The air was driven out of the pipe with sufficient force to give the hand a smart blow, to drive light substances out of it to the distance of half a yard, and to extinguish a candle, though it was 1039 yards distant from the place where the pistol was fired. A detailed account of these experiments may be seen in Nicholson's Phil. Jour. for October, 1811. Don Gautier, the inventor of the Telegraph, suggested also the method of conveying articulate sounds to a great distance. He proposed to build horizontal tunnels, widening at the remoter extremity, and found, that, at the distance of 400 fathoms, or nearly half a mile, the ticking of a watch could be heard far better than close to the ear. He calculated, that a series of such tunnels would convey a message 900 miles in an hour.

From the experiments now stated, it appears highly probable, that sounds may be conveyed to an indefinite distance. If one man can converse with another at the distance of nearly three quarters of a mile, *by means of the softest whisper*, there is every reason to believe, that

they could hold a conversation at the distance of 30 or 40 miles; provided the requisite tunnels were constructed for this purpose. The latter case does not appear more wonderful than the former. Were this point fully determined by experiments conducted on a more extensive scale, a variety of interesting effects would follow, from a practical application of the results. A person at one end of a large city, at an appointed hour, might communicate a message, or hold a conversation with his friend at another; friends in neighbouring, or even in distant towns, might hold an occasional correspondence by articulate sounds, and recognize each other's identity by their tones of voice. In the case of sickness, accident, or death, intelligence could thus be instantly communicated, and the tender sympathy of friends immediately exchanged. A clergyman sitting in his own room in Edinburgh, were it at any time expedient, might address a congregation at Musselburgh, at Dalkeith, or even at Glasgow. He might preach the same sermon to his own church, and the next hour to an assembly 40 miles distant. And, surely, there could be no valid objection to trying the effect of an *invisible preacher* on a christian audience? On similar principles, an apparatus might be constructed for augmenting the strength of the human voice, so as to make it extend its force to an assembled multitude of several scores of thousands; and the utility of such a power, when the mass of mankind are once thoroughly aroused to attend to rational and religious instruction, may be easily conceived. In short, intelligence respecting every important discovery, occurrence, and event, might thus be communicated through the extent of a whole kingdom, within the space of an hour after it had taken place.

Let none imagine that such an experiment is either chimerical or impossible. M. Biot's experiment is decisive, so far as it goes; that the *softest whisper*, without any diminution of its intensity, may be communicated to the distance of nearly three quarters of a mile; and there is nothing but actual experiment wanting to convince us, that the ordinary tones of the human voice may be conveyed to at least twenty times that distance. We are just now acting on a similar principle, in distributing illumination through large cities. Not thirty years ago, the idea of lighting our apartments by an *invisible substance*, produced at ten miles distance, would have been considered as chimerical and as impossible to be realized, as the idea of two persons conversing together, by articulate sounds, at such a distance. It appears no more wonderful, that we should be able to *hear* at the distance of five or six miles, than that we should be enabled to *see* objects at that distance by the telescope, as distinctly as if we were within a few yards of them. Both are the effects of those principles and laws which the Creator has interwoven with the system of the material world; and when man has discovered the mode of their operation, it remains with himself to apply them to his necessities. What the telescope is to the eye, acoustic tunnels would be to the ear; and thus, those senses on which our improvement in knowledge and enjoyment chiefly depends, would be gradually carried to the utmost perfection of which our station on earth will permit. And, as to the *expense* of constructing such communications for sound, the *tenth part* of the millions of money expended in the twenty-two years war, in which we were lately engaged, would, in all probability, be more than sufficient for distributing them, in numerous ramifications, through the whole island of Great Britain. Even although such a project were partially to fail of success, it would be a far more honourable and useful national undertaking, than that which now occupies the attention of the despots on the continent of Europe, and might be accomplished with far less expenditure either of blood or of money. Less than the fourth part of a million of pounds would be sufficient for trying an experiment of this kind on an extensive scale; and such a sum is considered as a mere *item*, when fleets and armies are to be equipped for carrying destruction through sea and land. When will the war-madness cease its rage? When will men cease from the work of destruction, and employ their energies and their treasures in the cause of human improvement? The most chimerical projects that were ever suggested by the most enthusiastic visionary are not half so ridiculous and *degrading* to the character of man, as those ambitious and despotic schemes would be, in which the powers of the earth in all ages have been chiefly engaged.—But, on this topic it is needless to enlarge till more extended experiments shall have been undertaken.

PLAN OF A WATER-TRAP TO PREVENT THE STENCH ARISING THROUGH THE GRATINGS OF THE COMMON SEWERS.

We have often had our nostrils most grievously offended by the stench arising from the common sewers, through the gratings, placed at the different corners of the streets of this city; and we believe there are very few of our Glasgow readers who have not, as well as ourselves, suffered under this most intolerable nuisance. In the summer months, in particular, it is often hardly to be borne; and, indeed, we would rather walk an additional mile or two, at times, than pass within a good many yards of the grating at the foot of Brunswick Place, which seems, in the dog days at any rate, peculiarly to annoy and distress its neighbours. We have often wondered that no attempt was made to remedy this nuisance; and, as nobody else has made any proposals on the subject, we have been thinking over it ourselves, and would suggest the following plan. Some of our intelligent Correspondents may probably make improvements on it; but, as it is, we should be very glad to see its utility tried at the grating we mention at the foot of Brunswick Place, where the smell seems most intolerable.

A, A, fig. 3, is the run from the grating at the Street to the common sewer below. Now, our plan is to form a small pit at C, which will be always filled with water up to the level at the dotted line C: a cast metal plate, B, must also be fitted in, which must dip about an inch into the water in the pit C. The distance between the bottom of the plate B, and the bottom of the pit C, will require to be large enough to allow all the water to pass which will be admitted by the grating at the top. The water will thus have free passage to the common sewer, while the smell is prevented from ascending by the iron plate B, and the water in the pit.

Since writing the above, we have seen an article, on the same subject, in Gill's Technical Repository, which we extract. We think our own plan, however, equally efficacious, and much less expensive than this proposition of ventilating by means of furnaces. However, we really think that something should be done, and earnestly hope the subject will be taken up by those more immediately empowered, to attempt some alteration.

"Mr. R. Bulkeley has recently proposed, in a Memorial addressed to the Mayor and Common Council of New York, *to remove the foul air of sewers, by means of purifying furnaces.* His plan is, to construct furnaces above the sewers, so that their draft may be supplied by the air of the sewers; consequently, currents of air will be made to set towards these furnaces, through the openings of the sewers, instead of the exhalations which now escape from them. The air of the sewers will have to pass through the fire, and the chimney of the furnace, before it can mix with the atmosphere; of course, it will be deprived of its noxious properties, by the decomposition it will undergo in the furnace. This is a subject of no little importance; since these exhalations, when concentrated, have been known to kill instantly; and, when more diluted, to cause malignant fevers, particulary around the openings of the sewers. Mr. B. contends, that no other effective plan of removing the evil can be devised; since the tide-waters cannot be depended upon, for cleansing the sewers, on account of the small rise of the tides (only five feet); and no other means

of forming a head of water, sufficiently powerful, can be adopted.

"We have extracted this article from '*The American Journal of Science and the Arts*.' Our readers will find, in Vol. III. p. 85, a similar proposal for ventilating the great north sewer of Paris, by '*causing a continued current of air to pass through the entire length of the sewer*; and which, by carrying off the gas as fast as it was formed, would also produce another useful result, namely, that of opposing the progress of fermentation, and, consequently, of diminishing the quantity of gaseous products.

"'In *all renewals of the air*, whether continually, or at intervals; and either by ventilating machines, *or by the action of fire*; it is necessary to know the quantity of air introduced in any given time.'

"The article then proceeds to indicate various methods of ascertaining this; points out different modes of disinfecting the gas; and ends, by shewing how it may be directed, either *into a lofty draught-chimney*, the temperature of which is elevated, by being surrounded with a stack of chimneys, heated, by being continually in use; or *into a stove or furnace*, as recommended by Mr. Bulkeley."

NEW VOLTAIC MECHANICAL AGENT.

We observe, in the last Number of the New Monthly Magazine, that this invention is noticed as having been made by the Editor of the Chemist; so that, notwithstanding the circulation of our Magazine in the Metropolis, the Editor of the New Monthly, it would appear, has not seen it, otherwise he would never have stated that as an invention of the Chemist, which had been announced a month previous by us. Thus it is, however, that merit is often robbed of its reward; and that the honour of a discovery is often denied to the original discoverer, whilst it is bestowed on some more clamorous and obtrusive individual, who may venture to set up a claim to it. For our own honour, then, as well as for that of our Correspondent, we are determined to vindicate his right to the original invention at any rate; and shall therefore allow no opportunity to pass of stating and enforcing his claims. We shall, therefore, make a point of sending to the Editor of the New Monthly the several Numbers of our Magazine in which this new Mechanical Agent is mentioned, leaving it with him to do justice to our contributor by noticing in his next Number that the invention he had announced as having been made by the Editor of the Chemist, had been previously made by a Glasgow Mechanic.

SUCCESSFUL APPLICATION OF JUKES' PUMP TO REMOVING POISON FROM THE STOMACH.

After the evidence afforded of the utility of this instrument, by the successful issue of its application in the case we are about to record, we should think that no doubt will longer remain on the mind of any one, as to the inestimable benefit which it is of, in cases where poison has been received into the stomach. It is quite clear, that in the present instance death must have followed, but for the use of this invaluable instrument; and after such a case, we think every

surgeon really culpable who does not instantly provide himself with one. Were they once into general use, death from poison, we believe, will hardly ever be heard of, except where it has taken effect before the danger is known. This instrument is besides admirably adapted for administering injections, and ought entirely to supersede the use of the pipe and bladder. Mr. George M'Leod deserves great credit for his introduction of this instrument into our city; but we hope, where it may be of so much use in the preservation of the lives of our fellow creatures, Mr. M'Leod will not long stand alone, and that his example will speedily be followed by many others among the respectable body of which he is a member.—We think it very unfair that this instrument should be called after Mr. Jukes, as it unquestionably was invented by Mr. Read of Bridge-house place, Southwark. Mr. Jukes has very candidly stated that the instrument was not of his invention, although he was the first to bring it into general use. But notwithstanding this, attempts have been made to take the merit from Mr. Read, and, by making trifling alterations, to take from him the benefit of a patent, which he obtained for his invention. None of these alterations, however, Mr. Jukes says, are improvements, they are rather, he thinks, alterations to the worse.

Some days ago, while Mr. Everitt, chemical assistant to Dr. Ure, in Anderson's Institution, and a young man, likewise belonging to the Institution, the mechanic who has constructed a number of the beautiful models in which it is so rich, were performing some experiments, they had occasion to open a drawer for the purpose of obtaining some apparatus which was necessary. In this drawer, among other things, soft extract of liquorice had been kept, and the young man, who had taken some opium to relieve a violent pain in his stomach, swallowed, in order to remove the naseous taste of the opium, a small piece of what he conceived to be the extract of liquorice, but which he immediately found to be extract of aconite. Mr. E. instantly gave him a large quantity of sulphate of zinc in solution, but could not excite vomiting. Tepid water was likewise very plentifully administered, but with equally little success. Having now become nearly speechless, he requested Mr. E. to obtain the assistance of Mr. G. M'Leod, Argyle-Street. That gentleman came instantly, and administered more of the sulphate of zinc, without, however, producing any effect. The stomach had lost all power, and very alarming symptoms were now exhibited; such as coldness of the whole system, dimness of sight, and violent spasmodic contractions of the œsophagus, so as to prevent deglutition. No resource was now left but the application of Mr. Jukes' instrument, which was immediately procured from the Infirmary; and by it the whole contents of the stomach were withdrawn. The effect on the patient was almost immediate; and he felt so much relieved by the removal of the first or second syringeful, as to be able to assist in the operation, by turning the stop-cocks. He was still, however, unable to swallow; a large quantity of tepid water was therefore introduced by the same apparatus, and again withdrawn, so as to wash the stomach clean from any remains of the poison. The patient had now none of the symptoms left but a slight coldness, which was soon removed by administering a little sulphuric ether. He then felt himself perfectly able to walk home; and after a good night's

rest, he not only felt himself free from any of the effects of the accident, but has since been freed in a great measure from his former troublesome complaint. It is quite impossible to withhold praise from these two gentlemen for the promptitude and coolness with which they thus exerted themselves to save the life of a very valuable member of society.

ON THE CAUSE OF SUNK FLATS AT A DISTANCE FROM THE RIVER BEING OVERFLOWED DURING THE LATE FLOOD.

We have heard considerable wonder expressed in conversation, and have seen some newspaper discussion, as to the cause of the sunk cellars and kitchens, at a distance from the river, being flooded during the late great swell, this having occurred in the Trongate, Argyle Street, and even West George Street. One person observes, in a letter in one of these Journals, that it is most likely either caused by the common sewers, or by water "flowing up through the sandy soil on which the city stands." He thinks it cannot be the last of these, because it is not likely that the river could affect the earth, and saturate it with water to such a distance; in this we agree with him. But he likewise, very unaccountably, thinks it cannot be the common sewers, because, if they are so leaky, why, he asks, does the water not exude through them at all times as well as when there is a swell in the river? We think this is all very easily explained. When the river is swelled, not only are its waters (which are now confined within a much narrower channel than formerly,) forced up the sewer to a considerable distance into the city; but the water flowing through them is prevented from getting away, and thus lies in the bottom, and exudes into the neighbouring kitchens and cellars. It is easy to see, therefore, how, when the water is prevented from going away by any other means, it makes its appearance where it is so little desired; and how, when it has free access to the river, it flows on without disturbing any one. It is certainly to be wished that measures could be adopted to prevent so disagreeable a circumstance as this in future; and surely the Superintendant of Streets ought to try some plan for this purpose. Sluices on the mouths of the sewers, where they empty themselves into the river, would probably not altogether prevent it, because while they keep the water from without from getting in, they will prevent the water within flowing out; but they would, undoubtedly, to a certain extent, remedy it, and probably would do so altogether.

ANSWER TO A LETTER ON ELECTRICAL CONDUCTING RODS.

[We at once give insertion to the following letter, which should indeed have appeared long ago. The present conductors assure the public, that nothing will ever be farther from their intention than to make a scientific journal the vehicle of personal abuse; and if by inadvertence personalities should obtrude themselves into their pages, they will ever be ready to make an explanation. In a word, if they admit a charge against any one, they will never refuse to insert an answer.

In inserting this letter, however, they beg it to be understood they only do so in order to exculpate the gentleman who is charged with that with which it would appear he had no concern; as to whether the thunder rods are properly or improperly insulated, they cannot say, as they have never made any personal observations on the matter.]

To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

SIR,—In No. XLII. Vol. II. of your Magazine, there is a letter on electric conducting-rods, of which, though disguised, it is not difficult to discern the real object.

Ostensibly your Correspondent's remarks relate to the different methods by which it has been attempted to isolate some of our public buildings, but it is quite obvious that this is but a secondary consideration with him, and that he has used the garb of science, merely for the purpose of attacking an individual, who, be it now known to him, had as little to do with the isolation of the jail and public offices as you, or your sapient Correspondent himself.

Had J. P. or whatever he chooses to call himself, been as well informed on civic affairs as he professes to be, he would have known that the electric apparatus on the jail, be it well or ill contrived, was placed there, not by the person referred to, but by the *advice*, and *under the direction and immediate personal superintendence* of the late Dr. Cleghorn, Professor of Chemistry in the University, who received from the corporation funds a fee for his professional services on that occasion.

Having thus illuminated your Correspondent, permit me to suggest to yourself, how detrimental to the interest and how foreign to the purposes of the Mechanics' Magazine, is the admission of such unfounded and personal remarks, as those I have thus felt called upon to allude to.

I am, your's, &c.

JOHN HERBERTSON, Jun.

Glasgow, 20th October, 1824.

ON THE FORMATION OF CLOUDS IN HOT CLEAR WEATHER, WHEN MOISTURE IN THE ATMOSPHERE CANNOT ACCOUNT FOR THEIR APPEARANCE.

IT is a fact well-known to chemists, that hydrogen is constantly given out from all vegetable and animal substances undergoing putrefaction —from stagnant water, wood, and various other bodies; but that it has not been found a component part of atmospherical air. This, again, is accounted for by chemists as depending on the great difficulty which exists of discovering its presence by analysis; but, as it is the highest body with which we are acquainted, it is more than probable, that, having a constant tendency to rise, it will therefore take the highest station in the atmosphere. It is a chemical law, that all bodies unite, so that the larger proportion has some multiple of the smaller—that is to say, always by entire numerals, and not fractionally.

It follows, then, that when the atmospherical air is diluted, and expanded by heat, it becomes specifically lighter, and ascends, and will then unite itself with the hydrogen in proportions of two parts to one. If it does not unite itself in its superior strata, it will in its inferior.

Now, one part of hydrogen, when combined with two of atmospherical air, becomes an explosive gas: it is this gas, which, by being ex-

ploded by the electric fluid, produces the phenomena of thunder and lightning; and the result of the combination of the oxygen of the atmospherical air, and the hydrogen by combustion, will be water. I have stood on the Alps, on a fine summer's evening, gazing on a sky of a beautiful cerulean hue, diverting myself by watching the occasional flashes of lightning as they glanced over the immense space above me, when I saw appear a speck, seemingly not larger than a bucket: the thunder groaned louder, and the lightning darting in repeated flashes, I saw the speck increase, (á vue d'œil,) and become in a few moments a cloud of considerable magnitude, which majestically moved off in a direction precisely contrary to the wind. The formation of this cloud, I have endeavoured to explain. To meteorologists, it is known both by the names of cirro cumulus and the cumulus stratas, which, uniting together, form the nimbu.

I have since noticed the same phenomena in Scotland; and, having Leslie's Hygrometer at my command, I made it a point to convince myself, that, during the time of the formation of the clouds, the air was in such a state of dryness as not to allow me to consider the clouds formed by the usual hypothesis.

LEONCE.

Edinburgh, Dec. 1824.

ECONOMY IN FUEL.

SIR,—At the present juncture, when "Coals are *coals*," it may not prove unacceptable to many—nay all of your readers, to learn, that by the following simple means, a saving of nearly one-third of that valuable commodity will be effected:—To one part of coal-ashes, add an equal quantity of the small-coal, or slack, and pour as much water on the mixture as will make it of the consistency of dough. In managing the fire, place a few round coals in front, then throw some of the *saving mixture* behind; when it will be found to give a warm and pleasant fire, accompanied with less smoke, less attendance, and less expense than the common method of fire-making—a very small part only will remain unburnt.—J. T.

MISCELLANIES.

C. S. Parker, Esq.—This gentleman, the son of C. Parker, Esq. Blochairn, near Glasgow, a most zealous naturalist, who studied the principles of botany under the celebrated De Candole, at Geneva, in a late visit which he made to his concerns at Demerara, formed a very large and valuable collection of the plants of Dutch Guiana. Proceeding thence to the West Indian Islands, during the last summer he chartered a vessel on his own account, with the view of rendering himself independent of the ordinary but uncertain mode of conveyance in those seas, and had already investigated many of the islands, when an accident occurred, than which none more disheartening can befal a naturalist,—the loss of his vessel, of the crew, and of the whole of his collections. Deeply as we sympathise with our young friend in this destruction of lives, and of a property (the amount of which, none, perhaps, but a botanist, who has himself gathered such treasures, under such a sun, and with so much toil and fatigue, can duly appreciate,) we cordially rejoice with his family in Mr. Parker's own safety.—We have been permitted to make the following extract from his letter, dated on board the *Mail Boat Endeavour, off Antigua, Sept. 23d*, 1824.

"When I had the pleasure of last addressing you from the roads of Basseterre, I little foresaw the circumstances of imminent danger in which I was placed, my

merciful preservation from which I can only ascribe to the gracious protection of an overruling providence. I disembarked at Basseterre on the forenoon of the 7th instant, with the intention of ascending the Souffriere, and starting next day for the islands to leeward. The exorbitant anchorage dues imposed by Admiral Jacob, amounting to thirty-four dollars upon a small vessel in ballast for a single night, decided the captain in lying off and on during the night. The afternoon was rather squally, and we had several heavy showers while ascending the mountain to a cottage where we spent the night. I awoke suddenly about midnight, and found that a tremendous gale was raging, tearing up forest trees by the roots, devastating the plantations, and doing incalculable damage to buildings and crops, particularly among the coffee trees and plantain walks. At dawn of day, when the fury of the storm had in some degree subsided, the devastated landscape presented an aspect truly dismal, while not a sail was to be descried on the agitated ocean. The loss of lives has been very serious, several vessels having parted from their cables, and grounded on the roads of Santas. Of the crew of one of them, a garda-costa, manned by thirty-two sailors and officers, not an individual survived to tell the tale. Fifteen days have now elapsed without a syllable of intelligence having reached me respecting the fate of my unfortunate schooner, which I had chartered, and on board of which were many objects invaluable in my estimation. But on these losses, and others which a mere pecuniary investment (heavy, indeed, in amount) may replace, my gratitude for my extraordinary preservation, and regret for the doom which I fear has befallen my companions, forbid me to permit my mind for a moment to dwell."

We have much gratification in being able to state, that of the collections made by Mr. Parker, those formed at Barbadoes, Trinidad, and St. Vincents, have safely arrived in this country. All procured after that period are lost.—*Edinburgh Journal of Science.*

Govan's Herbarium.—The herbarium of the late celebrated Govan, Professor of Botany at the University of Montpellier, has recently been purchased by Dr. Hooker, Professor of Botany at Glasgow, together with his correspondence, which, amongst those of many other eminent naturalists of that period, contains forty original letters of Linnæus. The collection, it is estimated, includes about 7000 species of plants, and, as may be supposed from the nature of the author's publications, is particularly rich in the productions of the south of France and the Pyrenees. There are likewise many plants from Northern Africa, Egypt, Arabia, (derived from Forskal,) Spain, and Peru. Their arrival in Glasgow is almost daily expected.—*Ib.*

Composition of an Ink similar to that brought from China. By M. J. Fontenelle.—Six parts of isinglass are to be dissolved in twice their weight of boiling water; and also, in two parts of water, one part of Spanish liquorice. The two solutions are to be mixed whilst warm; and incorporated, by a little at a time, with one part of the finest ivory-black, by the help of a spatula. When the mixture has been perfectly made, it is to be heated in a water-bath, till the water is nearly evaporated; and it forms a paste, to which any desired form may be given, by moulding it, as usual.

The colour and goodness of this ink will bear a comparison with the China Ink, or, as it is commonly termed, Indian Ink.

NOTICES TO CORRESPONDENTS.

A Constant Reader, Leslie, Fifeshire, will find his request attended to in our next.

ERRATA IN No. LII.

Page 364, lines 13 and 14, *for* " It is *heavier* than water, hence it *sinks* in that fluid," *read* " It is *lighter* than water, hence it *swims* in that fluid."

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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CURLL, PRINTER.

J. Grieson

THE GLASGOW MECHANICS' MAGAZINE,

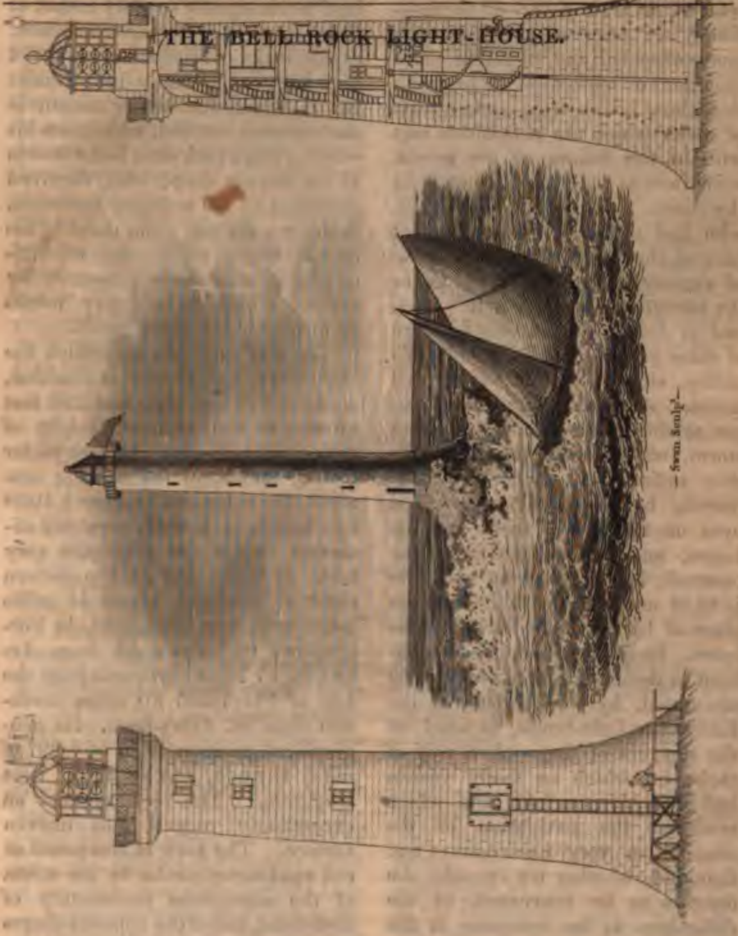
CONDUCTED BY

A Committee of Civil Engineers and Practical Mechanics.

" Far on the bosom of the deep,
O'er these wild shelves my watch I keep;
A ruddy gem of changeful light,
Bound on the dusky brow of night!
The seaman bids my lustre hail,
And scorns to strike his timorous sail!"

No. LV. *Saturday*, 15*th January*, 1825. Price 3*d*.

THE BELL-ROCK LIGHT-HOUSE.



ACCOUNT OF THE ERECTION OF THE BELL ROCK LIGHT-HOUSE.*

The dangers and the hardships which those who traverse the mighty deep are exposed to, are so many and so various, that it is among the most benevolent and the most useful offices to which science or art can be applied, to lessen, if not to remove, at least a part of them.—There are none of these dangers more concealed, and, therefore, more imminent or more difficult to avoid, than those arising from sunken reefs of rocks which are sometimes met with in the bosom of the ocean, sometimes at no great distance from the shore. Often the hapless sailor, who had visited the most distant part of the globe, for the purpose of conveying there the produce or the manufactures of his native land, and of bringing back the produce of more genial climates, beholds his native shores only to meet his doom. After escaping every danger arising from climate or from storm, with a heart yearning with love towards his home and his friends, he gazes with delighted eyes on the shores where all his hopes, and wishes, and joys are centred; but he gazes in vain! he is fated never again to behold the place of his affections, or those he loves. England, which is never behind in deeds of mercy, very early attempted, by the erection of the Eddystone light-house, to ward off the dangers of the sunken reef of rocks on which so many vessels had been shipwrecked, and which rendered the navigation of the channel so very hazardous: and Scotland, whether we consider the dangers to be prevented, or the difficulties to be overcome in the execution, can now boast in the Bell Rock light-house, a national work, equal in every point of view to any in the world. If, therefore, England has adorned the name of Smeaton with honours, which it is to be hoped will prove immortal, Scotland ought equally to glory in that of Stevenson. The planning of roads, canals, locks, or bridges has conferred high honour on many individuals; but to how much higher honour is the engineer entitled, who erects his structure on a rock sunk in the bosom of the stormy deep; who, deprived of almost all the ordinary resources, is thrown entirely upon those of his own inventive mind; and who triumphs over obstacles presented by nature, which to ordinary minds seem utterly insurmountable.

The reef of rocks on which the Bell Rock light-house is founded, is about 427 feet long and 230 feet broad; at the ordinary height of spring tides is about 12 feet under water; and from the floating sea-weed, the ridge can be traced 1000 feet farther in a south westerly direction, when the tides are very low. It is situated on the eastern coast of Scotland, about 11 miles south-west from Red-head, in Forfarshire; 12 miles south from Arbroath, 17 miles north-east from the Isle of May, and 30 miles north-east from St. Abb's-head. Its geographical position is in 56° 29′ of north latitude, and 2° 22′ of west longitude. The reef presents an exceedingly rugged and uneven surface. The rock is composed of red sand-stone similar to the strata of the contiguous promontory of Red-head, and of the opposite shores

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* Account of the Bell Rock Light House, including the Details of the Erection, and Peculiar Structure of that Edifice. By Robert Stevenson, Esq. F. R. S. E. Civil *Engineer.* 1 Vol. 4to. Pp. 534.

of Dunglas in Berwickshire: this red sand-stone belongs to the old red sand-stone formation which lyes under the oldest secondary coal formation. Mr. Stevenson seems to think that the Bell Rock may have originally formed the nucleus, now the ruins of a mass of land, which at no very remote period in the history of the globe, may have formed a small island above the reach of the highest tides. The present vegetation of the rock consists only of sea plants; some of them not of common occurrence on our coast. It is the occasional resting-place of the seal and the cormorant; and is the chosen residence of numerous marine *vermes*. At the distance of 100 yards, when the tide is low, the water varies from 2 to 3 fathoms in depth. The greatest depth between the rock and the opposite shores of Fife is 23 fathoms. This rock, though a mere spot on the surface of the ocean, produces all the remarkable phenomena of in-shore and off-shore tides, which are noticeable on the projecting coasts of the mainland, or among the Scottish Islands.

In the erection of the Eddystone light-house, the dangers and difficulties which were encountered and had to be overcome, owing to the smallness of the surface of the rock, were great and numerous; and although the surface of the Bell Rock was considerably larger, still it is more sunk in the water, and is only discovered at low water, the dangers to be encountered were, therefore, equally great and overwhelming.—Owing to the enlarged diameter of the rock, Mr. Stevenson was enabled to make the masonry of this building more than double the cubical contents of the Eddystone.

The following short table will exhibit to our readers the relative dimensions, &c. of the two light-houses.

	Eddystone.	*Bell Rock.*
Height of the rock, about	Level with high water mark.	Level with low water mark.
Height of masonry above the rock,	70 feet.	100 feet.
Diameter of the first entire course;	26 feet.	42 feet.
Cubic contents in feet, about	13,147.	28,530.
Expense understood to have been about	£21,000.	Ascertained, £61,331 9*s*. 2*d*.

Very early, no doubt, attempts would be made to obviate the dangers of this fatal spot; and accordingly, tradition reports that the monks of the Abbey of Arbroath erected a bell on the rock, which was to be rung by machinery affected by the flowing and ebbing of the tides, whence the present name of the rock, it is said, took its rise.

About the year 1800, the board of commissioners of the northern light-houses, a body organized in 1788, and to whose labours, which are purely *ex officii*, and without any remuneration whatever, the country is under the greatest obligations, being desirous of erecting a light-house on the Bell Rock, requested Mr. Stevenson, their engineer, to survey and to report as to the practicability of this being done. Mr. Stevenson did so, and reported that he conceived it quite practicable to erect one on the plan of the Eddystone light-house. His first landing on the rock was in the summer of 1800, when the boat's crew picked up a variety of articles of shipwreck, comprising a soldier's

bayonet, and a cannon ball, a hinge and lock of a door, a ship's marking iron, and part of a compass, several pieces of money, a shoe-buckle, &c. Although Mr. Stevenson at once saw the practicability of erecting the light-house, various opinions existed regarding it, in consequence of the rock being so far below the high water mark. Captain Brodie of the Royal Navy, proposed an erection on iron pillars; and different other modes were likewise projected. The commissioners, however, consulted the late eminent Mr. Rennie; and his opinion entirely coincided with Mr. Stevenson's. In the year 1803, a bill for the purpose was brought into parliament, but was lost in consequence of its being considered that it embraced too wide a range of coast for the collection of the duty. In the year 1806, another bill was introduced into Parliament, and passed into a law. This Act provided for a loan to the board of £25,000; and as there were surplus duties to the amount of £20,000 in the hands of the commissioners, the work commenced with funds to the amount of £45,000.

The operations began in the year 1807. From the insulated and distant situation of this rock, the first object of the engineer was to provide a convenient residence for the artificers, while engaged at the work. This was done by mooring a tender off the rocks, and on it a temporary light was exhibited.—A vessel was provided for conveying the workmen between the shore and the rock. The outer casing of the building was to be of Aberdeen granite, and the internal part of sand-stone. Quarries were opened near Aberdeen for supplying the one, and at Ringoodie, near Dundee, for supplying the other. The principal establishment on shore was at Arbroath, where a large yard was enclosed for the purpose of preparing the stones. A barracks was likewise erected for the residence of the workmen, when on shore. It was on the 7th of August 1807, that Mr. Stevenson accompanied by Mr. Peter Logan, his principal assistant, and a few workmen, went off to the Bell Rock and fixed on the site of the building. They immediately thereafter commenced their operations, by cutting away a thick coating of large sea-weed, and traceing the line of the foundation with pick-axes on the rock. At this time it was agreed on, that those workmen who went out to the rock should remain for a month without going ashore.—They, on the other hand, fixed their terms at 20s. per week, "summer and winter, wet and dry, with free quarters and victual when at the rock." Premiums, and the allowance they were to receive for working on Sundays, "they left to the honour of their employers."

At the commencement of this arduous undertaking, two or three hours' labour on the rock was considered a very good tide's work: and the men were then obliged to collect their tools and their implements, betake themselves to the boats, and, often under great disadvantages and with considerable risk and danger, seek refuge in the tender which was moored off the rock. To provide a temporary refuge for the workmen on the rock, in case of any accident happening to the boats, formed part of Mr. Stevenson's original design, and he accordingly lost no time in setting about the construction of a wooden beacon-house. This most necessary place of refuge was triumphantly completed in the latter end of September, and, as Mr. Stevenson says, "robbed the rock of much of its terrors, and gave a facility to the works which could not otherwise have been easily obtained."

The erection of this temporary

beacon-house forms an exceedingly interesting part of the history of this altogether interesting undertaking. Six beams, which were about 50 feet in length, were fixed upright on the rock, inclosing a space, the diameter of which was 35 feet, while they met in a point at the top. They were fixed at their base to the rock by great iron staunchions, weighing about 140 lb. each, which were sunk into the rock about twenty inches, and were wedged with successive slips of fir, oak, and iron: at the top the beams were bolted together, and strongly fastened by hoops of iron. The works at this stage depended entirely, it may well be supposed, on the state of the weather: they were obliged therefore to work on Sundays, and by torch light at night, when the tide permitted. The work was thus carried on under circumstances of peculiar hazard, and several very narrow escapes were made. The sloop Smeaton, which was used as a tender, at one time broke adrift from her moorings, carrying with her one of the artificers' boats; and from the current of the tides it was utterly impossible she could return until after the rock would be overwhelmed by the sea. At this time there were thirty-two men on the rock, and the two boats which were left would hold little more than half that number, especially in such a heavy sea. This accident of the breaking loose of the tender, and carrying away of the boat, was only known to Mr. Stevenson and the landing-master: the workmen sitting or kneeling at their work in the foundation pit, were in perfect ignorance of their perilous situation, till the rise of the sea drove them from the works, and made them seek their respective boats for their jackets and stockings. Their dismay and consternation on beholding two boats only instead of three must have been great; yet "not a word," says Mr. Stevenson, "was uttered by any one, but all appeared to be silently calculating the numbers, and looking to each other with evident marks of perplexity depicted on their countenances." A pilot-boat, however, bringing letters from Arbroath to Mr. Stevenson, fortunately arrived at this dreadful juncture, and thus they were all relieved from the rock, and set sail in search of the tender, which they reached and got safely on board of, though after a most dreadful passage, in which Mr. Stevenson's face and ears were encrusted with a film of salt from the sea-spray breaking over the bows of the boat.

(To be continued.)

ON VOLCANOES.

It has long been a favourite theory of ours, in contemplating man, that he who is possessed of the most outrageous or fearful passions, is often apparently the mildest and the most inoffensive; that, under a smooth and plausible exterior, often reside hatred, revenge, and vindictive malice; that, in a word, the man who could ravage countries, visit them with all the horrors of war, and sacrifice whole armies for the purpose of gratifying his boundless ambition, whose very heart, indeed, lay in his sword, had, even till his death, a brow unwrinkled by a single frown. When we turn to contemplate the physical world, this principle does not fail us. The heavens, which are now so lovely, will in a short time be overshadowed with gloom; filled with thunder and lightning, and the most tremendous tempests; and this fair earth, which

smiles so tranquilly under the cerulean sky, is pregnant with the most dreadful causes of desolation and ruin. The most beautiful portions of the globe, we find, are often devoted to all the horrors of volcanic eruptions and their awful accompaniments. Regions the most rich and fertile, have been overwhelmed by showers of dust and ashes. Imperial cities, and temples and palaces the most gorgeous and magnificent, have been overwhelmed for ever, or tumbled in ruins in the dust; and their very site has been engulphed, and become the crater of a volcano, or the bason of a stagnant and pestilential lake.

The most celebrated and delightful portions of Italy, the garden of Europe, have been modified or formed by the agency of fire. Proud imperial Rome herself, is founded on volcanic formation; the rock of the Capitol, which Roman vanity designated Eternal, is the tottering edge of a crater; and the beautiful *Campania*, which the Romans so falsely called *Campania Felice*, has been the creation of successive lavas, and owes its exuberant fertility to frequent showers of volcanic ashes. In fact, the whole of Italy presents every variety and gradation of volcanic and pseudo-volcanic phenomena.

It is beyond the power of man either to foretell or to prevent volcanic eruptions, or in any way to mitigate their dreadful consequences; but it is interesting to inquire into the most probable causes of such awful phenomena. Such inquiries, however, may well lead to great diversity of opinion, when it is considered that all the operations which we require to observe, and from the attentive observation of which our information should be obtained and our opinions formed, are so profoundly and effectually concealed from our view. The effects, and the products of these operations, are alone submitted to our examination; and, though they are prodigiously abundant, and the observers sufficiently numerous, there is a very plentiful scarcity of consistent evidence, and a most diversified assortment of conflicting and really ridiculous, though some of them apparently ingenious, theories on the subject.

The simplest, and undoubtedly the most ancient mode of accounting for volcanoes, is that which attributes them to the eructations of a central fire, which, as is assumed, occupies the centre of the earth. The existence of this central fire, however, which so conveniently removes all difficulties, and so pleasantly and amicably accounts for every thing, is extremely improbable, and is, besides, a mere gratuitous assumption. Not a shadow of evidence has ever been even attempted to be produced to prove the existence of such a thing, consequently this manner of accounting for volcanoes might at once be set aside: but it can easily be shown that such an assumption is perfectly inadequate to account for the various phenomena which volcanoes exhibit. For, admitting that the centre of the earth consists of melted matter, it must, from the length of time the fusion has continued, have obtained perfect homogeneity. There is no reason to suppose that this melted matter was not originally homogeneous; but, even although it had been originally heterogeneous, its long continued fluidity must, according to every known law, have produced a complete and chemical mixture. Such a homogeneous fluid must be in a state of perfect quiescence; and, although therefore we have admitted the existence of such a fluid at the centre of the earth, it can be no way available in accounting for the eruptions of volcanoes.

Professor Playfair, the ablest ad-

vocate of this system, tells us, indeed, in his illustrations of the Huttonian Theory, that in the mineral regions the effects of heat are fusion and expansion. But we at once ask how this expansion is produced? It cannot possibly result from a continuance of the same degree of heat. There are no known methods by which a homogeneous fluid can be expanded, except we increase the temperature till the fluid itself be rarefied; or introduce into it some new substance from which gas may be evolved. But, if we are to increase the temperature, where is the additional heat to come from? If we are to introduce a new substance, what is it to be, and whence is it to come? If we take this method of producing expansion, we will require a new assumption in order to obtain the yeast which is thus to set the bowels of the earth in fermentation. We cannot produce expansion by an increase of heat, as it is impossible we can obtain it, the theorists themselves having deprived us of the power of doing so, by depriving the central fire of all pabulum. As any increase of heat is thus rendered impossible, it must, in conformity to its well known laws, diminish, by equalizing the temperature of the surrounding bodies, and therefore cannot produce expansion. Water, it has been said, however, trickles on it from above; and the sea has been introduced for the purpose of increasing its commotion; but these attempts are equally futile and vain. Such a meeting of fire and water might produce earthquakes, with furious emissions of gasses, steam, and boiling water; but it never could send forth streams of melted lava or showers of pumice and ashes. If, in addition to supposing the existence of this melted matter, we could suppose the possibility of the water finding its way into the middle of the melted mass, we could conceive how it could produce an expulsion of lava, but not otherwise; but, unfortunately for our theorists, the possibility of water finding such a *resting place* is most effectually prevented by the inferiority of its specific gravity. If we pour water on melted iron, there will be no explosion: if we pour melted iron into water, still there will be no explosion: but if, on the other hand, we enclose a drop of water in a mass of heated metal, no known power can controul it.

Then, again, if we admit the homogeneity of the melted mass, and we cannot see how it can be denied, we come next to ask whence proceed the diversities of lava? In one place we have basalt as a lava; glass in another; pumice in a third; and earthy lavas in a fourth. How does this arise? How does it happen that we sometimes have sulphureous vapours, sometimes muriatic acid, and sometimes hydrogen gas? In short, it may in a word be asked, whence arise the perpetual variations of volcanic productions? The specific gravity of the earth, taken collectively, is found to be nearly double the average gravity of the rocks which compose its surface. The central fluid, whatever it may be, must therefore be of at least double the average gravity of rocks; but lavas, and volcanic glass, are generally under the medium gravity of rocks, and basalts are very little above it: how does this happen, if these are portions of the expelled central fluid.

This theory is certainly ingenious, and it has been adopted by many men of very brilliant and commanding talent; but it is quite inadequate to explain the phenomena which it attempts to elucidate. By assuming all that is required to be proved, it appears, at first sight, completely to overcome

every difficulty; but, after all, although we grant, to the fullest extent, the unwarrantable assumptions demanded, it is quite insufficient to elucidate what is required.

(To be continued.)

EDINBURGH SCIENTIFIC JOURNALS.

The January Numbers of these two rival Scientific productions, conducted by Drs. Jamieson and Brewster, have just been published. Both of them contain many valuable and interesting articles, some of which we may analyze for our readers in some future Numbers; but, in the mean time, we extract the following article, which must be very interesting to the lovers of Natural History:—

On the Emigration of a Colony of Caterpillars, observed in Provence. From the M.S. Tour of James Skene, Esq. of Rubieslaw.

In scrambling over one of the arid coteaux above Tolonai, the beautiful summer residence of our worthy old friend, Marshal Comté Gallifet, I was attracted by the manœuvres of a troop of emigrating insects, which amused me very much. It is very easy to attribute the singular economy in the actions of the insect world to the mere influence of instinct, as the governing principle of every living thing below the scale of reason; but we must either extend the meaning of that word beyond the mere actions of an involuntary impulse, or find it fall short of explaining much of what may be observed in the operations even of that lowest tribe of creatures. We readily lavish our admiration on the wonderful arrangements of some tribes, whose operations may be more particularly exposed to our scrutiny, but this may arise fully more from our deficiency of observation or opportunity, than from the inferiority of one class to another in the marvellous nature of their operations. Wherever our observation penetrates in the wide field of nature, we shall not want cause for wonder or motives for diffidence in the limited extent of our own faculties. It is admitted that instinct may account for their proceedings so long as they remain uninterrupted by opposition, but what must we call that species of intelligence that instantly proceeds to remedy, if practicable, any unforeseen accident that may interrupt their proceedings?

I observed, what appeared to me, a very slender snake, writhing across my path, which, but for the unusual season for these reptiles to appear, I should, no doubt, have passed unheeded. Upon examination, however, it turned out to be the orderly emigration of a colony of large caterpillars. They were proceeding assiduously along the rocky path, in a line of march by single files, and so close that they appeared to have a hold each of his neighbour's tail, and the continued wave formed by their motion had a very singular effect. The stony surface of the path rendered their progress exceedingly tortuous, and interrupted by much climbing over stones, as they seemed in general more disposed to go over the top of a stone than round its base. When such obstacles occurred, the march, notwithstanding, did not sustain the slightest derangement, as no troops could mark time with greater precision and patience than the rear of the line, while the front was engaged in climbing over any obstacle, or the leader had stopped to

examine the difficulty; the front, in their turn, tarrying until the rear had succeeded in surmounting the obstruction which the front had just passed. They were twenty-two in number, and nearly of the same size, except one, considerably larger than the rest, whose place was exactly in the centre of the line. The leader, on the contrary, was rather smaller than any of the rest. A large precipitous stone was in their way; the leader reared up, moving his head from side to side, as if gazing at it, or willing to reach some corner, and, leading his troop round, he frequently performed the same examination, until they reached a small bush, round the stem of which he ascended, the long line following with perfect confidence; and, by means of a branch of the bush, they attained footing on the stone.

Traversing the stone, the opposite side of which was quite precipitous and pretty high, it became uncommonly interesting to see how this intelligent general would proceed. He examined with accuracy, trying every possible break, during which time the main body remained patiently waiting, and without making the slightest attempt to assist in the examination, which their leader conducted with much activity and solicitude. At length, having ascertained the pass to be quite impracticable, he resolved upon a counter-march, which was instantly performed with the most surprising regularity. For the whole line in succession advanced to the wheeling point on the brink before they turned, performing the evolution with as perfect precision as the best trained troops, the advancing and retreating lines passing close alongside of each other, and even climbing the same twig, while the front line descended without confusion, passing even over each other's bodies without interruption or hesitation.

Having completed their descent in the same manner as they had mounted, a new line of direction was taken, which, however, was very soon most alarmingly interrupted by the arrival of a woman leading an ass loaded with brushwood, of which some branches trailed along the path. After the passage of this formidable assailant, I returned with some anxiety to examine the state of my colony, and found that they had suffered materially from the disaster, and were thrown into the greatest confusion. The line of march had been broken; a considerable body still followed the leader with a quickened pace; others, united in parties of three and four, regularly keeping their position in the rear of each other, while their temporary conductor sought, with evident anxiety, to find out the main body, hastening first to the one side and then to the other. A good many were scattered singly, and much distressed, seemingly uncertain how to proceed. I took each of them up in their turn, and with a view to ascertain the range of their vision, placed them at different distances from the main body, with their heads turned towards it, and I found that they uniformly remained quite unconscious of its presence, until placed within half an inch of each other. They then approached with evident eagerness, and were readily admitted into the line, by the rear halting until they had taken their places.

I put one of these stragglers in front, with his tail to the leader's head, but he pertinaciously refused the honour of conducting the line; a considerable sensation seemed to be communicated through the whole body at this attempt at usurpation, of which they seemed to become aware, but by what means I could not discern. As soon as this forced usurper was at liberty, he turned round to the leader, who repulsed

him with vigour, and bit at him; upon which he retreated hurriedly along the line, constantly trying to get into his place, but was bit at by every one as he run the gauntlet, till at last a good natured friend permitted him to join the line. I then took out the large one, who was obviously a stupid fellow, when the rear immediately closed up the breach. I placed him at the head, and used every inducement to make him take the lead, but in vain. He seemed much confused by the hearty buffets given to him by the active little Bonaparte whom I wished him to supplant, so that he probably would have failed in regaining his place, had I not given him some assistance, out of sympathy, for the distress my experiment had occasioned him. He seemed delighted to get into his place again; but was so much confused by the adventure, that he mistook the first sharp turn the line came to, and threw the whole rear into confusion. They broke their line, and much consternation and bustle ensued, until each had re-placed his head close to his neighbour's tail.

I now took up the leader, obviously less, though more active and intelligent than the rest, when the alarm instantly spread over the whole line. I expected the second to take the command, but he seemed the most distressed of any, and eagerly sought about from side to side, and in his perplexity he turned quite round, as if consulting with his follower. The hesitation and confusion was now universal. Various parties broke off as the impression reached the rear, and sought anxiously about, returning again to the line. Having replaced the leader at the head, he instantly took the command, advancing with confidence, and conducting the whole line in perfect order. When I now interrupted their march, the main body no longer exhibited their former anxiety and impatience when the leader was removed, but seemed to wait with perfect composure and confidence, until the obstruction was overcome, which the leader used every means and ingenuity to accomplish. It did not occur to me, till I had left these amusing travellers, to try the experiment of placing the leader in the rear, in order to observe how he would bear the degradation, and to ascertain if the head of the column would have been thereby changed.

STEAM NAVIGATION.

A PLAN has just been formed for establishing a regular communication by steam boats on the great Canal of the Two Seas, in the south of France. As the boats with lateral wheels, in common use, would present numerous difficulties in canal navigation, a new kind of boat, with a single wheel in the stern, has been invented by Messrs. Aynard, of Lyons. Similar boats are building at Lyons for the navigation of the Rhone; and it is asserted that they are equally powerful, cheaper in construction, and consume less fuel than boats of the common shape. A society is forming at Toulouse, with a capital of a million of francs, in shares of a 1000 francs each. They propose to establish four boats for passengers, and six for heavy goods, the former to go at the rate of 7000 toises (nearly $8\frac{1}{2}$ English miles) an hour with a burthen of 1200 quintals; the latter at the rate of 4000 toises (upwards of $4\frac{3}{4}$ miles) with a burthen of 1800 quintals. The passage-

boats are to be 86 feet long by 15 broad, handsomely fitted up with cabins and other conveniences. The chimney will be capable of being inclined in any direction so as to diminish the annoyance of the smoke. The wheel will be eight feet in diameter, and six feet broad, drawing about fourteen inches of water, and moving with a velocity of 10 to 20 revolutions in a minute. The boilers are to be of wrought iron, reduced from half an inch to a quarter in thickness, to prevent any danger of explosion. It is calculated that the light steam-boats will run from Toulouse to Bezieres, 133 miles by the Canal, in 32 hours, allowing seven minutes each for the passage of 78 locks. The present passage-boats take 78 hours for the same distance.

PROFESSOR ANDERSON AND DR. BIRKBECK.

[Although we have given insertion to these letters, we do not consider, with *Aliquis*, that we were bound to do so in consequence of our declaration, that, if we admitted a charge we would also admit the answer. Our meaning there evidently had a reference to any thing like personalities against the living getting into the Magazine: not to bickerings between nameless Correspondents. We have given insertion to these letters, because we wish to have the facts brought out; and we are always more desirous that this should be done by our Correspondents than that we ourselves should dogmatise upon the subject. However, we really beg our Correspondents, for all of whom we feel the strongest regard, not to quiz and abuse each other so unmercifully, as it certainly can do no good to science, and may do harm in making it impossible for us to insert their letters. B. must see that the strong expressions in his letter, have had no other effect than bringing out the wit of Aliquis; and the latter gentleman must now, we think, feel that all his wit has not added one particle to the strength of his argument. We must also recommend brevity, which has been said to be the soul of wit, as we cannot spare much room to such discussions. Yet we were anxious to give to the public, the extracts from the Will of Professor Anderson, which have been handed us by our respected Correspondent A. R. C. L. A. Y.]

To the Editors of the
Glasgow Mechanics' Magazine.

Gentlemen,—I was glad to see, in No. LIV. Vol. II. (for Saturday, 7th January,) an answer to W. G., as the discussion of the subject may tend to put the saddle on the right horse. In the outset, I think B. treats W. G. unfairly, when he states that he claims for Professor Anderson the merit of the invention of the steam engine. W. G. does no such thing; no more than we claim for the tree the honour of the discoveries of Newton, although its apple falling was the cause which turned the mind of that philosopher to the subject. Unless, therefore, there be an absolute "scoop-out" in B.'s *Conscientiousness*, (as Peter Pipestaple calls it,) he has no excuse for altering the plain meaning of W. G.'s words.

As to the merits of Dr. Birkbeck and Professor Anderson, B. would have acted more correctly if he had first procured a reading of the Will of the latter Gentleman, before pronouncing on whom the "*well-merited honours*" were to be heaped.* I have read that Will over and over, and I am quite convinced that what I here give, by way of notes, show that a Class was meant to be formed, in which artizans, who had not got a Mathematical education, might be taught the principles of philosophy, "that they may become eminent in their professions." The *fee* for this Class, as well as that of all the rest, was to be fixed by the Trustees.† Why this Class, or one similar to it, was not begun until the second year of Dr. Birkbeck's Professorship, is not for me to say; but, if we may judge from the History of Anderson's Institution, it seems to be, that the Directors conceived the Course they had already commenced, on the Tuesdays and Thursdays, consisting of 48 or 50 Lectures, for a fee of 21s., was of the same nature, and as cheap as was required; and, as a proof that Mechan-

ics did not consider this sum too much, we may adduce the numbers who attended Dr. Ure, when 24 or 25 Lectures were given for 10s.—being only a sixpence cheaper than what is paid by the first Class. However, in this they may have been mistaken, as they are "taken from certain most fanciful divisions of the community."

That no provisions were made as to economy of education, I must say is a gratuitous stripping off the honour due to Professor Anderson. He says, in his Will, that "no Professor, in this Institution, is to receive such large fees as to make drones of them;" ‡ that the sums paid to the Professors, and by the Students, is to be regulated by the 81 Trustees; and that no Director, or any person in the management, shall be allowed to receive any money, or in any other way be paid for his labour, than by the honour attached to the situation.§ Now, I would ask B. what was to be done with the funds of this Institution, if it had turned out a profitable concern, when none had it in his power to exercise his talents for grasping at them, as there is a body of guardians appointed, of whom the Magistracy of Glasgow forms a part, who can be called on, by B. or any other person, to look into the conduct of the ordinary Trustees, and, if they have done wrong, cause them to return to the right path again.‖ *I think there is something like economy in this.* As to what passed in Anderson's Institution about Dr. Birkbeck, referred to by B., it is not by what one man said, or another, nor even by the Sederunt Book of the Managers, (many of whom are not in possession of, and never saw a copy of the Will,) that I judge of the intentions of Professor Anderson; but I rest my opinion on the Will itself, and his conducting the experimental Course, above alluded to, for many years, to a class of workmen which he called his artificers. So I leave Mr. B.

I am, yours,

A. R. C. L. A. Y.

Notes taken from the Will.

* In Article 2d, he says, "I give, grant, dispone, and convey the whole of my other property, of every sort, to the public, for the good of mankind and the improvement of Science in an Institution."

Article 7th, after nominating the Trustees, is as follows:—"These eighty-one Trustees are appointed by me, in order to manage an University, or Studium Generale, for the improvement of Human Nature, of Science, and of the country where they live; and they are earnestly requested to accept of the office conferred upon them, for these reasons: That they will reckon it an honour to be Trustees, as they will be possessed of the power of managing an Institution that may, in time, be a great benefit to their kindred and their country."

† In Rule 1st, he says, "Lectures shall be given, according to the plan which I have long carried on in Glasgow College with great success, the Mondays, Wednesdays, Fridays, and Saturdays, being appropriated to the Mathematical part of Physics, and the Tuesdays and Thursdays being appropriated to the experimental part of Physics, without any Mathematics; the hours of Lecturing, as well as the Fee, to be regulated by the Trustees." He then, after enumerating the benefits to be derived from the Course that is at present carried on in the Institution, (that is the Natural Philosophy Class,) says, "Nor is this expecting too much, as it is well-known, that, *by* the Course of Experiments which I have given annually, *for many years*, according to the plan in my Institutes of Physics, upon the *Tuesdays* and *Thursdays*, the Manufacturers and Artificers in Glasgow have become distinguished, in a high degree, for their general knowledge, as well as for their abilities and progress in their several Arts." On these two days he was attended by many Mechanics, who are still in Glasgow: the fee for the Course was 21s.

‡ "The Professors are not to be allowed to be drones, or triflers, or drunkards, or negligent of their duty in any way, while every encouragement is to be given to such as are laborious and active in doing their duty."

§ "No part of the funds shall ever go to the Trustees; and, if any additions shall be made to the salaries of any of the Professors, it shall be done with prudence, and in order to encourage merit."

‖ "There shall be nine visitors of the conduct of the eighty-one Trustees; *to wit*, the Lord Provost of Glasgow," &c. &c. "who are to enforce a faithful administration."

To the Editors of the
GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—In your last Number, a person who signs himself B. indulges

his spleen by attacking, in a furious and ill-natured manner, the writer of an article, in a former Number, subscribed W. G.; and, from your promise to admit no attack without also admitting the reply, I request your insertion of the following remarks:—

The first fault this sapient writer finds in W. G.'s article is one which, I am persuaded, the youngest member of a Mechanics' Class would blush to avow: "he (W. G.) discovers that it is to the Professor, not to the mechanic," that the merit of improving the steam engine belongs; but where does B. find this discovery? Surely not in the paragraph he quotes from W. G.'s letter. "Had not our venerable founder," writes W. G. "required Watt's assistance in a very small matter, the steam engine of Watt, and the consequent wealth and prosperity of our country, as well as the glory of this day, *would never have had an existence.*" This is W. G.'s assertion, and I defy B. and the whole of his friends to *prove* the contrary. I call on him to prove that Newton would have discovered the Law of Gravity, without having seen an apple fall from a tree—that Galileo would have found out the Doctrine of Pendulums, although lamps had never been hung—or, to come nearer home, to prove that the Glasgow Mechanics' Institution would have had an existence, although Professor Anderson had never been heard of. When these are proved by B., but not till then, will I acknowledge that W. G. is wrong.

I suppose B. would consider it strange if I told him, that had it not been W. G. *his letter would never have had an existence.* Yet such is the case; and, if his legal knowledge can prove it otherwise, he had better do so; and if this is done, I will acknowledge W. G. to be wrong.

Having got over this mighty work, he proceeds in his examination of W. G.'s letter, and the next passage he stumbles over is this: "It is also worthy of remark, that this very Institution was, by the Will of its founder, established for the benefit of the *Manufacturers and Artificers* of Glasgow; so that to Professor Anderson may be traced the origin of all those *Mechanics' Institutions* which have since arisen in Britain—*an honour which has hitherto been ascribed to another individual.*"

This is the passage in W. G.'s letter which has given so much offence to Mr. B. He says the world have hitherto imagined "Dr. Birkbeck to be the founder of schools for the instruction of mechanics," and that he "will not see Dr. Birkbeck thus gratuitously stripped of his well-merited honours." Such are the assertions of W. G. and of B. It now remains that I endeavour to show which of the two have the right. Professor Anderson has been too long stripped of those honours which are his due, and W. G. deserves the thanks of the public for his attempt to replace them, and I hope the day is not far distant when the laurels shall be torn from the brow of the "*imaginary*," and strewed on the grave of the *real*, benefactor of his country.

Mr. Anderson was Professor of Natural Philosophy, in the University of Glasgow, for 41 years previous to the year 1795. While in that situation, he delighted in visiting the work-shops of the artizans, and gave them such information as was likely to benefit them in their respective arts. The idea then occurred to him, that if a Class were opened, to which they could be admitted, it would greatly promote their knowledge in their different arts; and accordingly he opened a Class, upon the Tuesdays and Thursdays, at eight in the evening, to which the public were admitted. Many availed themselves of this opportunity of improvement, *and in a short time, within the walls of Glasgow College, was there a large Class of operative artizans receiving instruction in a science which before that time was inaccessible to the public.*

Now, what shall we say of all this: (which B. himself cannot deny, because the facts can be proved by those who attended him, of whom I could name many still in Glasgow.) Was this not the first establishment in the world of a Mechanics' Class? It is of no consequence what were the fees at that time: it is enough *that it was established for Manufacturers and Artificers, and attended by them,* for thirty years previous to 1795. Where, now, I would ask, is the boasted honours of Dr. Birkbeck? Will B. still attempt to bolster up his opinion in the face of such facts? Were he to place these honours on his patron's head, they would blush that beheld them.

In consequence of the advantages which Professor Anderson saw had resulted from throwing open the doors of science to the operative mechanic and

the public, he made a Will, by which he bequeathed his property to the "PUBLIC FOR THE GOOD OF MANKIND AND THE IMPROVEMENT OF SCIENCE," and the Institution, which now bears his name, was opened in 1796. The management of it was committed to eighty-one Trustees, chosen from the different classes of the community, (of which "fanciful" classes *Lawyers* formed one,) under the control of the Lord Provost, Dean of Guild, and others; and, among other Rules for their guidance, the following are laid down in his Will, and I beg the attention of the reader to the distinct announcement of the founder's intention with regard to the public:—

"ARTICLE 9TH.—1*st Rule.* The Professor of Natural Philosophy, in this University, shall give Lectures, in the city of Glasgow, to be called "The Mathematical Course," every year, from the first day of November to the first day of May, according to the plan which I have long carried on in Glasgow College with great success: The Mondays, Wednesdays, Fridays, and Saturdays, being appropriated to the Mathematical part of Physics, without any experiments; and the Tuesdays and Thursdays being appropriated to the experimental part of Physics, without any Mathematics. The hours of lecturing and examination to be regulated by the Trustees, as well *as the honorarium or fee.*

"2*d Rule.* Besides the above-mentioned Course of Physical Lectures, another Course shall likewise be given by the same Professor, at least once every year, to be called "The Ladies' Course of Physical Lectures," in which no Mathematical reasoning shall be used; and it shall be similar to the Course on the Tuesdays and Thursdays above-mentioned; but with this difference, that the audience shall consist of both *ladies and gentlemen. The time of the year, the days of the week, and the hours of the day, the honorarium, and every thing relating to it, shall be appointed by the Trustees, under the direction of the ordinary Managers.* The intention of this Course of Lectures is, that the ladies in Glasgow may have an opportunity, *for a small sum,* and in the early part of life, of being at several of these Courses of Lectures, by which their education for domestic affairs will not be interrupted. No pedantic language will be acquired, as is often the case in a more advanced age, and such a stock of general knowledge will be *laid in as* will make them the most accomplished ladies in Europe. Nor is this expecting too much, *as it is well known that, by the Course of Experiments which I have given annually, for many years, according to the plan in my Institutes of Physics, upon the Tuesdays and Thursdays, the* MANUFACTURERS AND ARTIFICERS *in Glasgow have become distinguished, in a high degree, for their general knowledge, as well as for their abilities and progress in their several arts.*

"4*th Rule.* The ordinary Managers shall have a right to exclude from these Lectures, by the ballot, any person whatever, without giving any reason; that no men may be admitted who are disorderly, talkative, ill-bred, or intoxicated; and no women that are giddy or incorrect in their manners. If they do not like these conditions, they need not apply for tickets; for upon these conditions alone they can be received, and it is better that these nine ordinary Managers should sometimes be over severe than that any disorderly persons, of either sex, should be admitted."

"CODICIL.—*Section* 22. I expressly appoint and ordain that my funds shall, after satisfying my lawful debts, be applied, in the first place, to the maintenance of my Institution for teaching Physics or Natural Philosophy; and, in the next place, towards such of the Institutions, specified in my Will, as my Trustees shall judge proper, my intention being, that as soon as the funds can admit of it, the whole Institutions shall be carried into execution."

I would now call the attention of the public to these extracts, and ask any unprejudiced mind whether they now believe that Dr. Birkbeck has even the shadow of a claim as to being the founder of Mechanics' Institutions?

In reading the above extracts, it must be perfectly evident that the Professor contemplated that the Institution was for the benefit of the artificers and lower orders of the community, for he distinctly implies that the fee is to be small; and, farther, from the precautions he enjoins the Trustees to take regarding the conduct of those who attended the Class, it is indisputably certain that such was the purpose of the founder; *viz.* to give education, at a low rate, to the lower classes of the community; and his other classes are as evidently intended for the public at large. The word artificer conveys a more definite idea to the mind than mechanic—the former imply-

ing a workman, the latter a Student of Natural Philosophy. As the term is now understood, some of the members of both Institutions, I am afraid, would look *proud* were they termed artificers.

I should think enough has been said to prove that Professor Anderson is entitled to the honour which W. G. has assigned him, and that Dr. Birkbeck and his friends have gratuitously assumed them; but I have still a few words to say to B. regarding his honorary patron and his claims.

Among the artificers who attended the Class in the College, was a Mr. Smith, a gun-maker, who complained to the Professor's operator that he had little time to change his dress after his labour was over, and suggested the propriety of having a Class where they could appear without such transformation. This idea was communicated to Mr. Anderson, and met with his approval. His Will embodied this approval, by establishing the Class where no Mathematical reasoning should be used; and, if this was not the first establishment of a Mechanics' Class, I should be obliged to B. to tell me what it was. Mr. Anderson's operator, who is still in town, and can *prove* what I have said, mentioned this to Dr. Garnet, and the matter was taken into consideration by the Trustees before Dr. Birkbeck came among them, and Dr. Garnet mentioned it to him; so that Dr. Birkbeck has, to say the least of it, great presumption in taking any merit whatever to himself in the matter. So much for the opinion of his two aged friends, Black and Robertson.

While Dr. Garnet was Professor, the Classes were well attended by the public, including mechanics, who paid the fee then demanded without hesitation; but, when he went to the Royal Institution, (the idea of which had been taken from Anderson's,) and Dr. B. came in his place, the mechanics of Glasgow found that his abilities were not such as to induce them to pay the former fee. The Classes, of course, fell off; and, in order to recruit them, he had recourse to the expedient of giving *gratis* Lectures—but even this could not court popularity, and he at last gave it up as not worth the attention he had bestowed on it.

B. asks why this Class was not begun sooner, if contemplated in the Will, and he will find an answer to this in the clause formerly quoted; but I would ask him why is the Mechanical Drawing Class, in his Institution, which was to have been conducted by Mr. Warren, not yet established? The answer to the former is much easier than to the latter.

B. tells us, very gravely, that the words "Manufacturers and Artificers" were commented on, but "the Class agreed, with the Committee, that nothing in the Will gave the slightest countenance to the notion that Professor Anderson contemplated the Mechanics' Class," from which admission it is evident, that, whatever Messrs. Warren & Co. affirmed, was agreed to by the Class, however absurd it might be. Indeed the absurdity of the whole business, at that time, is evident from what they say was laid before the Directors and agreed to by them—an assertion which carries its refutation on its very face. The following is one of the articles; and, because (they say) the Directors agreed to it, and afterwards denied it, they found it necessary to secede—"That the apparatus already belonging to, or that may yet be purchased by the Class, and the present Library, or what books may yet be purchased, shall be secured to the Mechanics of Glasgow for ever; and, should they at any time find it necessary to withdraw from the Institution, they may remove them to any other place they think proper." Now, I beg the reader to observe, that all the property of the Institution already belongs to the public at large, and is managed by the Trustees for them. How, then, could they give the property of the public to a few mechanics? The idea was ridiculous in the extreme. The property is secured to the mechanics as well as to the other divisions of the public, but can never be removed from Anderson's Institution. So much for the demands of a faction.

I have now done with B. and his patron; and, whether W. G. or B. are in the right, I leave the public to judge. Perhaps B. may yet favour the world with some "dreams" and "prophecies" on the subject.

ALIQUIS.

12th January, 1825.

MISCELLANIES.

COLOMBIA.

Institutions for Knowledge.—In Colombia, the population of which is reckoned at four millions of inhabitants, there are eighteen journals, forty new schools of mutual instruction, ten colleges, one in each of the chief places of the ten departments of the Republic, and three Universities, at Bogota, Caraccas, and Quito. There are taught in the schools all the sciences cultivated in Europe, except political economy and the mechanic and industrious arts. The French language is there particularly cultivated: the public library of Bogota, which is composed of 14,000 choice volumes, contains a great number of French works.

Combustion of Iron by Sulphur.—Dr. Hare makes this experiment in the following manner:—A gun-barrel is heated red at the butt end, and a piece of sulphur thrown into it; then either blowing through the barrel, or closing the mouth with a cork, will produce a jet of sulphureous vapour at the touch-hole, to which if iron wire be exposed, it will burn as if ignited in oxygen gas, and fall in fused globules of proto-sulphuret of iron.

Eruption of Sulphuretted Hydrogen.—A singular phenomenon has occurred on the river Calfkiller, near the salt-works, about three miles from Sparta, (Turna,) in the United States of America. A column of fire, nearly forty feet high, rose from the waters in the middle of the river; it extended over a space of fifty roods, and illuminated objects at a considerable distance, the tints thrown over them were red, green, yellow, blue, &c. It seems to have been occasioned by a sudden burst of sulphuretted hydrogen, which was inflamed by the approach of a lighted torch. The liberation of the gas is attributed by some to the operations of the workmen who were looking after salt, but the explanation seems doubtful.—*Rêvue Encyclopédique.*

German method of making Flowers grow in Winter.—"We saw off such a branch in any tree as will answer our purpose, and then lay it for an hour or two in a running stream, if we can find one: the object of this is to get the ice from the bark, and soften the buds. It is afterwards carried into one of our warm rooms, and fixed upright in a wooden box, or tub, containing water. Fresh burnt lime is then added to the water, and allowed to remain in it about twelve hours, when it is removed, and fresh water added, with which a small quantity of vitriol is mixed to prevent its putrefying. In the course of some hours the blossoms begin to make their appearance, and afterwards the leaves. If more lime be added, the process is quickened; while, if it be not used at all, the process is retarded; and the leaves appear before the blossoms."

Preservation of Vegetables.—Vegetables may be preserved all the winter, particularly French beans; by filling a middle-sized stewpan with young peas, for instance, into which must be put two or three table-spoonsful of sugar, and the stewpan then set over a brisk charcoal fire. When the heat begins to act, stir up the peas two or three times; then, as soon as they begin to yield water, pour them out into a dish to drain. Spread them out on paper in an airy place, not exposed to the sun, and turn them frequently, so as to dry rapidly. Guard them from moisture, and you may have them green at Christmas.—*New Monthly Magazine.*

NOTICES TO CORRESPONDENTS.

M. N.—S.—J. P.—A. B.—Vinarius.—Tyro.—J. T.—&c. have been received.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of Steuart & Panton, Cheapside, London; and Edward West & Co. Edinburgh.

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MECHANICS' MAGAZINE,

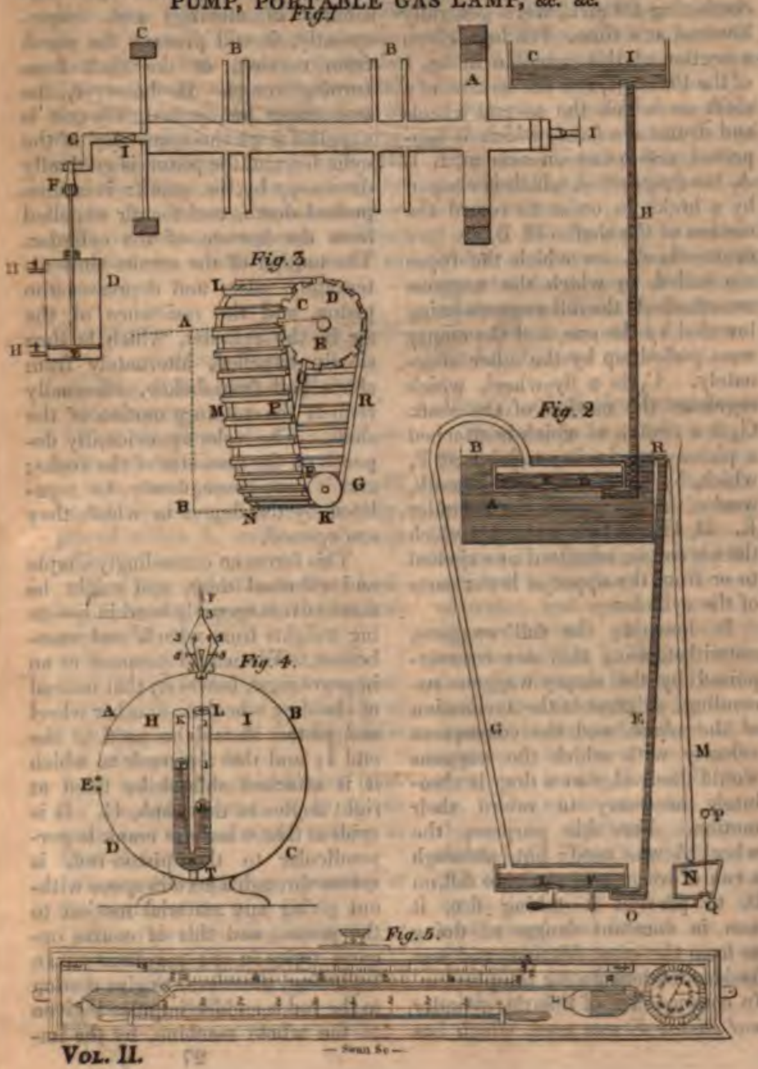
CONDUCTED BY

A Committee of Civil Engineers and Practical Mechanics.

———————" All constraint
Is evil: hurts the faculties, impedes
Their progress on the road to Science; blinds
The eye-sight of Discovery.

No. LVI. *Saturday, 22d January,* 1825. Price 3d.

IMPROVED DRAG FOR LOWERING GOODS, SELF-ACTING PUMP, PORTABLE GAS LAMP, &c. &c.



IMPROVED DRAG FOR LOWERING GOODS.

On Lord Lonsdale's property, near Whitehaven, we saw a very excellent drag, which was used there for lowering coal waggons, on an inclined plane, from the coal-hill to the wharf, where the coals were shipped. The angle of depression seemed to us to be about 35°, and from six to seven waggons, each containing 20 cwt., were generally lowered at a time. We have given a section of this machine in fig. 1 of the Plate. I, I, is the section, of a shaft on which the several wheels and drums are fixed, which is supported and turns on axis at I, I. A, is a drag-wheel, which is clasped by a brake in order to retard the motion of the shaft. B, B, are two drum-wheels, on which the ropes are coiled, to which the waggons are attached; the full waggons being lowered by the one, and the empty ones pulled up by the other alternately. C, is a fly-wheel, which regulates the motion of the shaft. G, is a crank, to which is attached a piston-rod, having a joint at F, which, by the motion of the crank, works the piston in the cylinder E. H, H, are two cocks, by which the air can be admitted or expelled to or from the upper or lower parts of the cylinder.

In lowering the full waggons, notwithstanding they are counterpoised by the empty waggons ascending, so great is the inclination of the plane, and the consequent velocity with which the waggons would descend, that a drag is absolutely necessary to retard their motion. For this purpose, the wheel A was used; but, although a run of water was made to fall on it, to prevent it taking fire, it was in constant danger of doing so from the great friction, and was besides inadequate for the purpose. In consequence of this the cylinder *and piston* E was used, which has been found to be a most effectual drag, and to lower the waggons with the greatest ease and security. The manner in which this cylinder acts as a drag, is very easily explained. It is air-tight, of course, and when the cocks at H, H, are shut, it is evident the piston will remain fixed without the possibility of moving; and, consequently, it will prevent the crank from moving, or the shaft from turning round. If, however, the two cocks be opened, the air is expelled from the upper part of the cylinder, and the piston is gradually drawn up by the crank: it is then pushed down, and the air expelled from the bottom of the cylinder. The motion of the cranks thus alternately raises and depresses the piston, and the resistance of the air in the cylinder, which is thus slowly expelled, alternately from above and from below, effectually retards the rotatory motion of the shaft. The velocity evidently depends on the diameter of the cocks; and it can, consequently, be regulated by the degree in which they are opened.

This forms an exceedingly simple and effectual drag, and might be most advantageously used in lowering weights from wharfs and warehouses. We would propose as an improvement, however, that instead of the drag wheel A, another wheel and piston should be used at the end I; and that the crank to which it is attached should be fixed at right angles to the crank, G. It is evident that when the crank is perpendicular to the piston-rod, it moves through a certain space without giving any material motion to the piston, and this of course occurs twice in one revolution. In beginning, therefore, to give motion to the rod, a sudden impulse is given to the whole machine, by the im-

mediate action of the piston: and were it not for the drag-wheel, it (the machine) would be liable to be broken, and the waggons would be allowed to move with their full velocity. Were the additional cylinder and piston used, however, which we suggest, the two cranks acting at right angles to one another would make a uniform motion, and entirely prevent this.

IMPROVED SELF-ACTING PUMP.

[At the request of some of our country readers, we have given this plan of a Self-acting Pump. We do not know if it is exactly the one they mean, but it is decidedly the best we have seen. If they find any difficulty in the application of it, we shall be very glad to give them our advice on the subject, provided they write us particularly as to the manner in which they wish to use such a pump, and the situation in which they mean to use it.]

Description of an Improved Self-acting Pump.

A, fig. 2, is a cistern filled by

B, a spring.

C, a cistern to which water is required to be raised.

D, a metal (water-proof) box, 12 inches square and 4 inches deep, placed within A, and near the top of it.

E, a pipe of half-inch bore, leading from the top of A to the bottom of F.

F, a metal box, similar to D.

G, a pipe of half-inch bore, leading from the top of F to the top of D, the upper part of it being above the level of B.

H, a pipe of half-inch bore, leading from the bottom of D to the bottom of C, and made as long as from R to S.

I, a valve (opening upwards) at the mouth of the pipe H.

K, a valve (opening upwards) at the bottom of D.

L, a valve (opening upwards) at the bottom of F.

M, a pipe which takes the overflowing water of E to

N, a small light pan, which, if filled with water, bears down O.

O, a lever, which, when pressed down by N, opens the valve L.

P, a pin, to which is fastened a piece of chain, having at its end a flat piece of leather, which, when N is pressed down, leaves it, and opens a hole at Q.

Q, a hole in the bottom of N, which must be made of a proper size, for the purpose of letting the water escape from N, in the same time that is required for D to be filled with water through K.

Mode in which the Pump operates.

The vessels D and F being full of air, the water of A runs into E, expels the air from F, through G and D, to I, and fills E, F, and G, to the level of B. It then runs over at R into the pipe M, fills N, which is borne down by the weight of water, and opens L and Q, as above described; the vessel F then empties itself at L, is filled with air from D, through G, and D is filled with water through K. In the same time, N is emptied through Q, and returns to its place, allowing L to shut, and leaving F and G full of air. The water continues running through E, expels the air from F, through G, into D, which air expels the water from D, through H, up to C, until F and G are filled with water, and D with air, when the machine is found in the same state as at first, F and G being filled to the level of B.

This self-acting pump may be applied to many uses. If a person has a spring which supplies his house with water at the level of the middle storey, he may place F in the kitchen, and C in the bed-room, aad every gallon of water used in the kitchen, will give a corresponding gallon (or very nearly so,) in the bed-room.

In using this pump, the pipe E may be supplied with impure or even very dirty water, and the whole of the spring B will be raised to C, instead of half of it being perhaps wasted at L; and in this manner any spring may be pumped up to the requisite level without one drop being lost, merely by forming a dam, or lead, as in mills, and obtaining a fall for a part of the water equal to the height to which it is requisite to pump up the spring.

It is not necessary that R should be on a level with B. It may be far above or below it, and the effect will be nearly the same. The water will rise a sligh above D as from R to S.

The rain-water collected on the top of a house, will pump up a corresponding quantity of pure water from a well as deep as the house is high; but this pump will be found most useful where a large body of water is to be raised through a small height.

The great superiority of this pump consists in its acting almost entirely without friction.

A pump of the above dimensions, (which are very diminutive,) continued working, without being touched, for three months, and raised eight hogsheads of water every day.

DOUBLE OVERSHOT WHEEL.

To the Editors of the
Glasgow Mechanics' Magazine.

Gentlemen, — The following method of employing the weight of water in moving machinery, will, if theory and practice agree in this case, increase the effect one half more than the common water wheel.

It may easily be shown that in the case of the overshot wheel, the efficient power is only about two-thirds of that which the water is capable of exerting, when properly employed; and this arises from the circumstance that the weight of the water acts under a mechanical disadvantage, except when in the same horizontal line with the centre of the wheel. By the following method, it will be found that the water always acts at the same distance from the vertical line passing through the centre, and it will, therefore, exert one-half more power than in the overshot wheel.

Suppose A, B, fig. 3, of the Plate, to be the height of the fall, and C, D, E, a wheel whose centre is in the same horizontal line with A; L, M, N, O, and C, P, K, R, are two chains passing round the wheels, C, D, E, F, G, H, with rings that pass upon nobs or teeth on the wheel, C, D, E. To these chains the buckets are fixed, and it is obvious that the water in falling from A to B, in a vertical direction, always acts at the same distance from the vertical line, passing through the centre of the two wheels.

The wheel C, D, E, does not require to be large. If it be very small, however, the friction upon its axis will bear a greater proportion to the power of the water, and occasion a greater loss of power, and if it be too large, its inertia will produce a similar effect.

I am, Gentlemen, your's, &c.
A. B.

Dollar, 11th Jan. 1825.

PORTABLE GAS LAMP.

To the Editors of the
GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—I send you a plan for burning gas, contained in a portable vessel, with an equal flame. A, B, C, D, (fig. 4.) is the vessel, E the opening at which the gas is forced in, by means of a pump, and F is the jet at which it escapes and is consumed. H, I, is a bar to support the glass tube K, S, L, open only at one end. The space from K, to the float P, contains mercury. The two floats, P and R, are connected by the string or chain X, Y; and to the top of the float R the stout wire Z, Z, Z, is attached perpendicularly. To the top of this wire is affixed a cubical piece of metal, shaped on *all sides* like a wedge. This is contained in a kind of box marked 3, 3, 3, 3, which is also shaped wedge-like, but with a greater angle at the bottom; 4, 4, are two metal plates, each exactly the same size as one side of the box. These plates are to be pushed backwards or forwards by the screws 5, 5, till the aperture is adjusted, when the ends of the screws may be cut off.

Now, suppose the cubical vessel A, B, C, D, empty of gas, the mercury in the tube is alike high at both surfaces. The forcing pump is applied at E; and, as the gas is condensed, it compresses the air in the end of the tube at K: of course the mercury rises, carrying the float P up along with it; the other ball is drawn down, and brings down with it the wire Z, which gradually stops the opening at the top of the wire; and, as the gas contained is diminished, the pressure will be taken off the surface of the mercury at R, the air at K will expand, and raise the wire Z, and enlarge the opening.

I am, GENTLEMEN, your's, &c.

JAMES JONES.

Edinburgh, 1825.

DESCRIPTION OF THE SYMPIESOMÈTER.

THE principle of the Sympiesometer, which is represented in one of its forms in the Plate, fig. 5, consists in employing an elastic fluid or gas, different from air, and any liquid, excepting quicksilver, which neither acts upon the gas which it confines, nor is perceptibly acted upon by the air, to the contact of which it is in some measure exposed. Hydrogen gas, azotic gas, or any of the gasses not liable to be absorbed by the inclosing fluid, may be used; but I prefer hydrogen gas as superior to any other that I have tried. The liquid which answers best is an unctuous oil, or a mixture of unctuous and volatile oils. I consider almond oil, coloured with ancusa root, as the most eligible.

The Sympiesometer consists of a tube of glass, A, B, C, of about 18 inches long, and 0.7 of an inch diameter inside, terminated above by a bulb, A, about two inches long inside, and half an inch diameter; (but this will vary, as the instrument is required to have a greater or lesser range;) and, having the lower extremity, B, bent upward, and expanding into an oval cistern, C, open at top.

The bulb A, at the upper end of the tube, is drawn to a slender thread, and is at first left open. In order to introduce the gas and oil, I fill the bulb and tube with quicksilver: Then, holding the tube horizontal, a communication is formed between a gasometer, containing the gas to be used, and the slender pipe at the end of the bulb A, by means of a flexible tube. As the

tube is brought to a vertical position, the quicksilver flows out till it descends in the tube to the level of the top of the cistern, and the gas enters to supply its place. The slender pipe is then to be sealed hermetically close to the bulb A, by a touch of the flame of a blow-pipe.

The tube A, B, C, is now to be inverted, and the mercury poured out of the cistern C, allowing the column which occupies the tube to run towards the bulb, to prevent the escape of the gas. The tube being again turned into a vertical position, the portion of quicksilver which remains is removed, by pouring some of the oil over it, and heating the gas, until, by its expansion, it forces the column of quicksilver which is left at the lower end of the tube, into the cistern; then, holding the tube nearly horizontal, the oil will enter as the gas cools, and the remaining quicksilver may be poured out of the cistern C.

The inclosed gas which has thus been introduced, changes its bulk, or occupies more or less space, according to the pressure of the atmosphere upon the surface of the oil in the cistern C. The scale *m*, *n*, for measuring the change in the bulk of the gas occasioned by a change of pressure, is formed experimentally, by placing the instrument in an air-tight glass-case, along with an accurate barometer and thermometer.

The glass-case is furnished with a condensing and exhausting syringe, by which any density may be given to the inclosed gas, so as to support a column of quicksilver in the barometer of 28, 29, 30, or any other required number of inches. The height of the oil in the tube of the Sympiesometer corresponding *to these points* being marked on its scale, and the spaces between being divided into a hundred parts, these parts correspond with hundredths of an inch, on the scale of the mercurial barometer.

As the bulk of the gas is altered by any change that takes place in the temperature of the atmosphere, it is necessary to apply a correction on this account. For this purpose, the principal, or barometric scale, *m*, *n*, is made to slide upon another scale, *o*, *p*, placed either below it or on one side of it, which is divided into degrees and parts, so as to represent the change of bulk in the gas produced by a change of temperature under the same pressure, and corresponding to the degree of a common thermometer attached to the instrument.

This scale is constructed in the same manner as the scale of a common thermometer, by changing the temperature of the bulb while the pressure is the same, and noting the range of the oil occasioned by it.

In using the instrument, observe the temperature by the thermometer, and set the index which is upon the sliding Sympiesometer scale, opposite to the degree of temperature upon the fixed scale; and then the height of the oil, as indicated on the sliding scale, will be the pressure of the air required.

When the height of one place above another is to be measured by the diminution of the pressure of the atmosphere, another correction is necessary to insure perfect accuracy in all instruments indicating this change, because the pressure of a given altitude varies according to its humidity of moisture.

A new Hygrometer has therefore been added to the Sympiesometer by the inventor, of which we shall give a description in an early Number.

ACCOUNT OF THE ERECTION OF THE BELL ROCK LIGHT-HOUSE.

(Continued from page 405, Vol. II.)

In the progress of the works in the Summer of 1808, a considerable addition was necessary to the shipping establishment. Besides the floating light-ship which had been moored off the rock, a schooner of 80 tons was provided as the principal tender. Stone-lighters of 40 tons were also provided for the conveyance of materials; and three praam boats, each capable of carrying about 10 tons upon deck. These last were employed for removing the stones from the lighters anchored off the rock to the wharfs and cranes on the rock. They were doubly fortified by a water-tight ceiling, or lining, in case of damage by being grounded upon the rock, and were farther prepared for the worst by a number of empty casks, which were stowed under deck, and were of themselves capable of keeping the praams afloat. There were also several attending boats for transporting the artificers from the tender to the rock, and one of them was fitted up as a life-boat upon Gratehead's principle. The moorings of the various craft consisted of chains, with cast-iron mushroom anchors, admirably adapted to the situation. Tracks of iron railways were laid upon one level, along the rough and uneven surface of the rock, on which the great blocks of stone were wheeled upon waggons also constructed chiefly of cast-iron. The little wharfs were provided with cranes adapted to the peculiarities of the respective situations. A descriptive account is given by Mr. Stevenson, in his work, of the various cranes, sling-carts, stone-jack, winch-machine, and Lewis-bat for quarrying purposes, of the moulds for stone-cutters, pumps, and other *machinery*, in a detailed manner, extremely interesting to the engineer and the architect.

It is not a little surprising to see how pleasantly and cheerfully the workmen spent their time, notwithstanding the extraordinary dangers and difficulties to which they were continually exposed; and they appear to have been perfectly contented with the rations of provisions, the pay, and the premiums which they received. At first, the whole time of flood-tide was a period of leisure. During such periods, the amusements to which the men resorted were as various as their inclinations. Some, fond of reading, were busily engaged at their books; some, who were more musically inclined, played the violin or the flute; and others amused themselves by fishing. The great evil, however, of which they all complained, and which time itself hardly cured, was sea-sickness. Every nerve was therefore strained to erect a barracks for their accommodation upon the beams on the rock, which was at once to relieve them from the constant liability to sickness, and from the danger and perplexity of the movements, both by night and day, in boats to and from the rock. The force of habit, however, under such perilous circumstances, is finely exemplified in the testimony borne by Mr. Stevenson to the readiness with which men, little versant in sea affairs, were brought to embark with alacrity, and to work with the tool in one hand, and the lighted torch in the other, on a solitary sunken rock, at midnight, and in darkness, amidst the howling of the wind and the roaring of the waves. The scenes witnessed, and the peril of their situation, must have been often

fearful. "On one occasion," says Mr. Stevenson, "the wind being at south-west, we had a pretty heavy swell of sea upon the rock, and some difficulty attended our getting off in safety, as the boats got a-ground in the creek, and were in danger of being upset. Upon extinguishing the torch-lights, about twelve in number, the darkness of the night seemed quite horrible; the water being also much charged with the phosphorescent appearance which is familiar to every one on ship-board; the waves, as they dashed upon the rock, were in some degree like so much liquid flame. The scene, upon the whole, was truly awful."

By strenuous and unremitting exertions, the beacon-house was erected, and the foundation-pit of the building prepared, by the middle of the month of July, in this the second season of the work. The foundation had the appearance of a great circular platform, of compact red sand-stone, measuring 42 feet in diameter, surrounded by an irregular margin of rock, rising from 18 inches to five feet. In the work-yard at Arbroath, where the materials were prepared, the first and second courses of the light-house now lay ready for being shipped for the rock. Each stone was accurately marked, so that its relative position in the building on the rock could at once be recognised. The stones were cut of a dove-tail form, on a plan similar to those of the Eddystone light-house. The foundation stone at the Bell Rock was laid by Mr. Stevenson, with masonic ceremony, on the 10th of July, 1808. "Whether we consider," he remarks, "this building as an erection of great difficulty, or, in a nautical point of view, as adding much to the comfort and protection of the mariner, and safety of property, upon a range of coast extending to almost the whole eastern shores of Great Britain, its importance is evident. If it be proper, therefore, on any occasion to attach importance to the act of laying the first stone of a public building, that of the Bell Rock light-house cannot be said to yield to any in point of interest, either for the peculiarity of its situation or the utility of its object. Under these considerations, it is obvious, that but for the perilous and uncertain nature of any arrangement that could have been made for the ceremony, instead of its having been performed only in the presence of those immediately connected with the work, and a few accidental spectators from the neighbouring shores, counting in all about eighty persons, many thousands would have attended upon an occasion which must have called forth the first dignitaries of the country, in conferring the highest honours of masonry. The writer may, however, confidently affirm, that, situate as the rock was, nothing could add to the sensation felt by all present, in having now got matters in so advanced a state as to be able to commence the building operations." After this period the work went on with much alacrity, from ten to twenty blocks of stone being generally laid in the course of a tide. Owing to the use of cranes instead of the mere ordinary apparatus of their poles, much precision and facility were given to the operations of the builders, and by the latter end of September the works were brought to a conclusion for the season.

"The building being now on a level with the highest part of the margin of the foundation-pit, or about five or six inches above the lower bed of the foundation-stone, is computed at 388 tons of stone; consisting of 400 blocks connected with 738 oaken trenails, and 1215

wooden wedges. The number of hours of low-water work upon the rock, this season, was 265, of which number only 80 was employed in building. It was, farther, highly satisfactory to find that the apparatus, both in the work-yard at Arbroath and also the craft and building apparatus at the rock, were found to answer every purpose much beyond expectation. The operations of this season, therefore, afforded the most flattering prospects of the practicability of completing the solid part of the building, or 30 feet of the light-house, in the course of another year."

The builders returned to their barracks, and work-yard at Arbroath, for the winter; and, on the tender's entering that harbour, the artificers were greeted with cheers from their friends and comrades on shore, who thronged upon the quays to welcome their return. This season's success, however, was chequered with a cross accident, in the loss of a sailor from one of the stone-lighters.

(To be continued.)

EXPEDITIOUS METHOD OF CONVEYING MAILS.

To the Editors of the
Glasgow Mechanics' Magazine.

Gentlemen,—The following is a plan for the conveyance of Mails, more powerful and rapid than any, I believe, hitherto suggested; and at no period has there been such a spirit for enterprise, and such a probability of carrying such a plan into execution.

Dispatch is said to be the life of commerce, and no pains or expense have been spared to give facility to communication between one place and another. Roads and carriages have been progressively improving, and animals are now urged to their utmost; so that little more can be effected by these means. Among other modes of conveying intelligence, the modern invention of the telegraph is the principal; but it is not adapted to the purposes of commerce.

I observe an extract in No. LIV. Vol. II. which contains some curious speculations on the transmission of sounds to any distance through tubes; but the idea is not new. I have been familiar, since my childhood, with a story of the Romans using that method of conveying intelligence at the wall of Antoninus, or Graham's Dyke, which, as is well known, was a line of forts, with a ditch and mound, from one to another. It is said there were earthen tubes concealed in the wall, through which they spake from one fort to another. This mode of conveying intelligence is no better adapted to commerce than the telegraph; and, in every other respect, is far inferior to it.

The plan I propose, is to impel hollow balls, containing the letters, through pipes similar to those for conveying gas or water, or to project them through the air by an adequate power, such as condensed air, steam, or gunpowder. In using the two latter, as they act by a single impulse, the pipes might only be continued to where the impulse ceased, and the passage widen into a kind of tunnel, with a smooth bottom, so that the air might the easier give way, allowing the ball to proceed by the momentum it had acquired, with the least possible obstruction. In using air for driving forward the balls, a small steam engine would be required at each station, which might act either by highly condensed air, or on the principle of blowing with an equal and

continued blast, drawing the air from the pipes behind, and forcing it into those before. By the latter method, the progress of the ball could be continued to any distance, were interruption not necessary for sending off lateral branches. If a powerful impulse were employed, the commencing pipe at each station would require to be very strong, or a kind of cannon; but pipes, all of the same strength, would be sufficient, if a regular continued blast were prepared. In any of these methods, there would be an aperture in the pipe to admit the ball, with a strong cover, air-tight, that might be fastened in an instant. The ball being packed with the letters, the keeper of the station would place it in the tube, shut the cover, let on the power, and it would be off in an instant. When it arrives at the next station, let it set off an alarum bell, or fall into a vessel with sufficient noise to put the keeper on the alert; who, having his pipe open, ready to receive the ball, puts it in its place, and lets it off as before. Supposing the main pipes 15 inches diameter, a hollow sphere, or ball, same size, might probably contain nearly 1000 letters, one of which might be dispatched as soon after another as was found necessary.

If the blowing principle were preferred, the engine might work an air cylinder similar to those of a blast furnace, for the purpose of impelling a current of air through the pipes, and the ball along with it. This principle may be understood by the amusement of blowing peas, &c. through a tube, often practised by boys, to the annoyance of others. There is little doubt of the practicability of projecting the balls through the air by cannon, without the expense of pipes of any kind; for in this case the cannon could be immoveably fixed, so as always to throw the ball to the same spot, allowing for other circumstances causing some deviation; the utmost extent of which might be included in a space of ground railed or walled in, the surface of which might be made to decline to the next cannon and keeper's lodge, so that the ball would roll to hand wherever it lighted. Either gunpowder or steam might be employed: assuredly this would be a much pleasanter use of the former of these tremendous engines than the destruction of mankind.

It would be tedious to enumerate all the advantages of these plans; but, besides the immense saving of time, they would not be subject to interruption from storms, floods, robberies, and other causes. It may be objected, that if I thought the above plan valuable, I would not thus publish it, without securing any advantage from it. To this I answer, from its nature it cannot be carried into effect but by the Government, or by Joint Stock Companies, with the concurrence of Government, which sufficiently secures any consideration the invention of it might merit.

As to any person publishing a version of it, in their own name, a month afterwards, as has recently been done with another invention, it is not easy to prevent this, if they are ambitious of the reward such an attempt is likely to receive.

I am, Gentlemen, your's, &c.

G. M.

Glasgow, 17th January, 1825.

IMPROVEMENT ON POWER-LOOMS.

A very ingenious townsman has, *it is said*, made a valuable improvement on the Power-Loom, by which the aid of steam, or any other agent,

except the person attending the looms, is dispensed with in driving them. We have not been able to obtain any particulars as to this improvement, and no one, it seems, is allowed to see it; but it consists in enabling the woman, or boy, who attends the two looms on the present plan, to drive them as well as attend to them and keep them in order. This will be making one do the work of two, and will prevent the necessity of using steam in these mills at all. It will therefore be a great saving of expense if it is found to succeed, but we doubt very much the whole affair.

LONDON MECHANICS' INSTITUTION.

The pleasant feelings with which the commencement of this Institution was contemplated, have been greatly lessened by its subsequent success. At first the Mechanics of London flocked to it in great numbers; but it seems, of late, they have lamentably decreased in their attendance. From any thing we can learn, the radical fault in the Regulations of that Institution is allowing the rich and the wealthy to have any share in its management. At first, but a limited number were to be admitted into the Committee, but this Regulation has not been attended to, and the management has been almost entirely taken out of the hands of the working Mechanics, for whose benefit and instruction it was originally intended. This was a vital error. If there was any wish that the Institution should succeed, or that it should prove useful for diffusing knowledge among the working classes, it should have been left entirely in their own hands. There should have been no great men to wither it with their patronage; no wealthy men to injure it with their liberality. It should have been left entirely to the management of those who were principally interested in its welfare. The intention on the part of those who interfered, we believe, was good: but it was mistaken kindness. The Glasgow Mechanics' Institution had no great *men to overwhelm* it in its infancy, with the weight of their well-intentioned patronage: it received little, or rather no assistance from the wealthy. It was projected, and carried into effect, we may say, almost exclusively by operative Mechanics, and its success has been triumphant. Some attempts were made at interference with its concerns, but they were firmly and strenuously resisted. The interference of persons not properly concerned is carefully guarded against in the Laws of the Institution. An honorary patron has no doubt been nominated, and the honour has been bestowed on one most worthy of it, Dr. Birkbeck, but he has no vote nor right to interfere in their proceedings. The Glasgow Gas-workmen's Institution, an account of which we presented to our readers in a late Number, owes its success to the same cause. The men have the entire management of it themselves: the proprietors do not interfere with it in the smallest degree. At the commencement of that Institution, a desire was expressed by the members, in the height of their gratitude to Mr. Neilson, who had originally suggested the idea to them, to appoint him President of the Institution for life; but, abundantly conscious of the deadening effect which this would have, it was firmly resisted by him; and the consequence has been, that the men take a strong interest in its prosperity, and it is

now most prosperous. Thus it is that the Institutions we have now alluded to, increase in usefulness and the power of diffusing knowledge; while the London Institution, in spite of all that has been done for it, is withered and seems about to die. Give the management of that Institution entirely to the Mechanics, who are, or at least ought to be, most interested in its success, and it will yet prosper; but continue the management it is at present under, and it must die, or at least linger out a weak and useless existence. It is not the gifts and donations of the great, however beneficial they may be, which will make it prosper: the Mechanics must be interested in it; and the only way to interest them is to give the entire management to themselves. There is no danger of their being unable to manage it. Indeed, it is this absurd fear of trusting them, and belief that they must be guided and assisted by greater and wiser men than themselves, which has proved the bane of the London Institution. In a Committee of rich and poor men, the rich men naturally take the lead: the exertions of the poorer men, however intelligent they may be, are thus completely paralyzed; and carelessness and disgust must be the inevitable consequence. Knowledge, in the greatest and wisest sense, is power undoubtedly; but wealth is also power; and, in intercourse with the world, wealth will be found invariably to overwhelm and paralyze the influence and effect of knowledge, wherever they unfortunately happen to come into contact.

SUCCESSFUL APPLICATION OF JUKES' STOMACH PUMP.

It is gratifying to be able to record that the life of another human being has been saved by the application of this most valuable instrument: thus, within a very few weeks, have two lives been preserved, which but for this could not have been effected by all the aid which medicine could afford. On Sunday evening last, about five o'clock, a poor woman, residing in High-Street, swallowed, in a fit of despair, in order to put an end to her existence, upwards of an ounce of laudanum. It was soon known to her friends, and a Surgeon was sent for, who administered large quantities of sulphate of zinc, but without the smallest effect. About six o'clock a message was sent to the Infirmary, and two of the House Surgeons came immediately, bringing with them the Stomach Pump. The wretched patient seamed unwilling any thing should be done to preserve her, and made great resistance to its being used; so that the gentlemen met with considerable difficulty in getting her mouth opened, in order to introduce the tube. After some resistance, however, the mouth was got opened, and the tube was introduced: the stomach was then emptied of its contents, and afterwards washed out with warm water, as in the case of the person at Anderson's Institution. At the time the Surgeons from the Infirmary attended, it was evident, from the state of the patient's eyes, that the poison had begun to operate; and, from the quantity she had swallowed, it is unquestionable that death must have followed. She was, however, immediately relieved by the application of the instrument; and was afterwards taken to the Infirmary, where some medicine was administered, and she got a cup of strong coffee. On Monday she was quite well, and able to leave the Infirmary, perfectly freed from any of

the effects of the poison. It is impossible sufficiently to enforce the necessity there is for every Surgeon providing himself with one of these instruments; and it is not difficult to see that any one, in whose hands a patient dies from the effects of poison, in consequence of one of these instruments not being at hand, has great blame attachable to him. We would suggest that in the case in which the apparatus is kept, an instrument should likewise be kept by which the mouth could be forced open where there is an unwillingness to allow the apparatus to be used, as there was in the present case.

PROFESSOR ANDERSON AND DR. BIRKBECK.

To the Editors of the
GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—Your *joint* Correspondents, Aliquis, and he who makes himself witty with my name, must have known me little, if they imagined that it was either their personalities or their abusive anonymous letters, which could give me the least uneasiness.

It is not my present intention to enter into the subject, under the disadvantage of being thus drawn before the public, and having to contend with persons in the dark, especially with those who, having discovered me to be the writer of the letter B, (in what way they best know,) have chosen to convert a public question into a vehicle for gratifying personal spleen, how excited, however, I have yet to learn. So soon as either of these gentlemen please to step from their concealment, they will find me ready to meet them on the subject, in whatever way they may incline.

At present, I would merely join with yourself in remarking, that all the witticisms of your Correspondents have added nothing to the question. I gave statements accompanied with all the necessary qualifications of time, place, and circumstance. If wrong, I could easily have been corrected, *but not a single assertion I have made has been contradicted.* If they had been contradicted, I could have easily established them. If they be true, as in the absence of any denial I am entitled to assume, then let the public judge who is in the right.—But Aliquis has discovered a third solution, not much however to the credit of his friends, namely, that my assertions may be true, but they merely show that "whatever Messrs. Warren & Co. affirmed, was agreed to by the class, *however absurd it might be !*" Does Aliquis mean that the aged Messrs. Black & Robertson palmed a deliberate falsehood on the class, when they affirmed that they were the agents through which Dr. B. formed the Mechanics' Class? Did Messrs. Hart & Watt falsify Professor Anderson's will, or was it through ignorance that they and the committee joined in misleading the class, as to its tenor? Did Dr. Ure falsify the sederunt book, or was it from ignorance that he gave a similar opinion on its contents? And, lastly, did Dr. Ure, the committee, and the five hundred subscribers to the address, prepare and subscribe that paper either wittingly or ignorantly, containing what was not the fact? It is for your Correspondents to take which horn of the dilemma they choose.—To me it is matter of indifference.

Many quaint allusions are made to my profession, but it surely requires no legal ability to discover that statements like those at the bottom of the first column of page 415, may lead to results little expected.

At present I will not farther pursue the subject, but, as I never wish to speak nor write that to which I would be ashamed to adhibit my name, I thus deprive my opponents of all farther scope for their attic wit, by subscribing myself

HUGH BARCLAY.

ON THE FORMATION OF CLOUDS.

ONE of the most remarkable actions exerted by electric fluids, is the disunion of several compound bodies. Messrs. Hassinger & Berzelius first determined that when electricity passes through a liquid, the principles of this liquid separate, so that some are collected around the positive pole, the others around the negative.

This is fully demonstrated in the action of the pile on water. If the wires be introduced by separate corks into a vessel containing the fluid, the one connected with the positive end of the trough of an oxidable metal, will become rapidly oxidized, while from the negative wire, hydrogen will be evolved. If instead of an oxidable metal, gold or platinum be used, oxygen will be given out and the gasses will be found to exist in that proportion which by their union compose water.

To obtain the same resultss from ordinary electricity, Dr. Wollaston in the Philosophical Transactions for 1801, makes use of the same plan, excepting that the wires instead of being exposed to the fluid contained in the vessel, throughout their whole length were covered with wax, and their points only laid bare.

Mr. Bennet discovered a fact of great importance, that different bodies, when brought into contact either by their whole surface, or by a single point, acquired different states with respect to their quantities of electricity. This has since been confirmed by experiments made by Volta and Davy.

From these experiments, oxygen, judging from those compounds in which it is loosely combined, is found to be negative; and hydrogen, by the same test, positive. Now, if the common laws of electrical attraction and repulsion operate, as there is every reason to believe they must among bodies so constituted, it will follow that hydrogen being positively electrified, will be repelled by surfaces that are in the same state of electricity as themselves, and will be attracted by surfaces that are negatively electrified; and, *vice versa*, oxygen being in a negative state, will be attracted by positive surfaces, and repelled by negative ones.

If water can be decomposed by electricity, it will be natural to draw the analogy that vapour can.

This being the case, the vapour, as it ascends, will be decomposed by the electric fluid existing in the atmospherical air, and that in different proportions, according to the different states of the atmosphere. For example, in hot dry weather, when the electric fluid is in great quantities, it will be natural to suppose that it will resolve more water into its primitive, or gaseous form, than during cold damp weather, when a great portion of water will remain in the state of aqueous vapour, held in solution by the atmospherical air, which can easily be demonstrated by exerting the power of those bodies which have a greater affinity for the water than the atmosphere has allowed it. Indeed it is from this suspension of aqueous vapour, in the atmospherical air, that the hypothesis has been formed that the air, after becoming saturated, the superabundant vapour becomes condensed, and forms clouds—but this Dr. Johnson says is false; and, indeed, was it true, the rain would fall in a very different manner. But, to continue, the gasses being disengaged, each will take its relative situation: the hydrogen, from its great lightness, ascending to the higher regions; the oxygen uniting with the atmospherical air, by chemical affinity.

It is this theory of the electrical decomposition of vapour which alone can account for what becomes of the vapour, during the long periods which sometimes occur without any fall of rain, especially in the tropical climates. But, as we have already demonstrated, the moment these gasses become electrified, the one positively and the other negatively, the agency of the electric fluid will overcome the chemical affinity existing between the oxygen and the nitrogen, and the two gasses will attract one another.

Grothus has asserted, that water is silently formed by a continued succession of electric sparks, when a mixture of hydrogen and oxygen, in certain proportions, exists under diminished pressure; therefore, when the gasses are mixed, the electricity being liberated, acts upon them, and the result will be the formation of clouds.

LEONCE.

Edinburgh, Jan. 1825.

QUERIES.

What is the best receipt for making Ginger Beer?—Z. A.

What is the reason that a thin kind of crust is sometimes formed on the out-side of bottles which contain Port wine?—VINARIUS.

GENTLEMEN,—If you deem the following queries worthy of a place in your Magazine, their insertion will much oblige, your's, &c.

B. R. D. R.

Jan. 17th, 1825.

Ought the pistons of all steam engines to move with the same velocity, whatever be their diameter or length of stroke?

Granting this, what advantage does the engine of 6 feet stroke possess over that of 4 feet stroke, their diameters being the same?

Queries for Builders.

The cements being equally good—

First, What thickness of stone walls, of different kinds, say rubble, parapet, and ashler, is equal to the different thickness of brick walls:—that is to say, what thickness of each of the three is equal to a brick wall of 18 inches, and so on with the other thicknesses?

Second, Whether should the joists of a house be nailed firm to the wall-plate, or allowed a little play at the ends, letting them depend on their inflexibility to support the floor?

Third, Could the floors of houses that are not furnished with separate ceiling-joists, be laid without cracking the ceiling below: or what prevents the flooring deals from being laid, before the ceiling is finished underneath them?

Fourth, What is the best method of preventing water from coming up through the ground into the sunk flats of houses in such floods as we had of late in the Clyde? In some it having forced its way up through, and even shifted the stone floors after all other openings were shut.

MISCELLANIES.

Singeing of Fabrics.—In the List of Patents enumerated in the last No. of the London Journal of Arts and Sciences, we observe the name of Mr. John Burn, of Manchester, for his Invention of a new Apparatus for dressing various kinds of Cotton, Flaxen, Woollen, or Silk Manufactures. The purpose of this newly invented apparatus is to singe the surface of cloths, or other fabrics made of cotton, flax, wool, or silk, in order to remove the superfluous fibres of the thread, which give a downy appearance to the fabric, before it has been dressed by singeing. Red-hot cylinders have usually been employed for this purpose, over which the articles have been passed rapidly, and by that means the fibres burned off, without injury to the threads. The flame of oil lamps, spirit lamps, and gas burners, have also been employed; but these flames have generally been permitted to pass through the interstices of the woven material, and thereby to burn the internal fibres, as well as those on the surface, and which has tended considerably to weaken and injure the substance of the fabric. The present patentee intends to employ a burner or lamp of gas, oil, or spirit, as he may find most desirable; but it is for the construction of his machinery that the patent is obtained, and not for the material used to produce the flame; by which machinery he purposes to singe both the surface of the fabric operated upon, without permitting the flame to pass through its interstices.

New Island.—The Kelso Mail newspaper mentions the discovery of an Island in the South Pacific, by Capt. B. Wight, of the merchant vessel Medway. It is in lat. 21° 36′, long. 159° 40′ W. of Greenwich. Its length from East to West about 20 miles; the land high. Captain W. named it Roxburgh Island, after his native country.

Radish.—The boiled roots of this vegetable form an excellent dish when served up as asparagus.

VARNISHING.

General Observations.

It is the custom, in order to heighten the beauty of fine wood, and give an additional lustre to furniture, &c. to varnish it; the simplicity of the process requires but little to be said on the subject, but, that nothing may be wanting to benefit the workman, I shall endeavour, as clearly as possible, to lay down some rules and cautions necessary to be observed, both in the making, and method of using varnish, that the work may appear as beautiful as possible.

In London it is hardly worth while to make varnish, unless in large quantities, as there are several shops where it may be had very good, and at a fair price; but, in the country, where the carriage is an object, and you cannot depend upon the genuineness of the article, it is necessary to be

known by the practical mechanic. The varnish, in general, sold for varnishing furniture, is white hard varnish.

Cautions respecting the making of Varnish.

As heat, in many cases, is necessary to dissolve the gums used in making varnish, the best way, when practical, is to use what the chemists call a sand bath, which is simply placing the vessel in which the varnish is, in another filled with sand, and placed on the fire; this will generally be sufficient to prevent the spirits catching fire; but, in case of such accidents, (which not unfrequently happens,) it will be best to take a vessel sufficiently large, that there shall be little danger of spilling any; indeed the vessel should never be more than two-thirds filled. but, in case of accident, have ready at hand a piece of board sufficiently large to cover the top of the vessel in case of its taking fire, as also a wet wrapper, in case it should be split when on fire, as water, by itself, thrown on it, would only increase the mischief; and the person who attends the varnish pot, should have his hands covered with gloves, and if they are made of leather, and rather damp, it will effectually prevent injury. I would particularly impress these cautions on the workman, as, from practical knowledge, I have several times witnessed shocking personal injury from the neglect of these cautions.

General Directions in choosing the Gums and Spirits used.

When you purchase a quantity of gum, first examine it, and see that it consists for the most part of clear transparent lumps, without a mixture of dirt; next, when you get it home, select the clearest and lightest pieces for the most particular kinds of varnish, reserving the others, when separated from extraneous matter, for the coarser varnishes. In choosing spirits of wine, the most simple test is by immersing the finger in it, and if it burns quickly out without burning the finger, it is good; but if, on the contrary, it is long burning, and leaves any dampness remaining on the finger, it is mixed with inferior spirit; it may be also compared with other spirit, by comparing the weight of equal quantities, the lightest is the best; the goodness of spirits of turpentine may be likewise ascertained in the same manner by weighing it, and by noticing the degree of inflammability it possesses, the most inflammable is the best; and a person much in the habit of using it, will tell by the smell its good or bad qualities; for good turpentine has a pungent smell, and the bad a very disagreeable one, and not so powerful.

To varnish a Piece of Furniture.

First observe the work to be clean; then see if any knots or blemishes require filling up, which must be done with cement of the same colour; have your varnish in an earthen pot, with a piece of wire diametrically across the top, slackened downwards, to stroke the brush against; then see that your brush is clean, and free from loose hairs, dip your brush in the varnish, stroking it across the wire, and giving it a thin and regular coat; soon after that another, and another, always taking care not to pass the brush twice in the same place; let it stand to dry in a moderately warm place, that the varnish may not chill.

When you have given your work about six or seven coats, let it get quite hard, (which you will prove by pressing your knuckles on it, if it leaves a mark it is not hard enough;) then with the three first fingers of your hand rub the varnish till it chafes, and proceed over that part of the work you mean to polish, in order to take out all the streaks, or partial lumps, made by the brush; give it then another coat, and let it stand a day or two to harden.

NOTICES TO CORRESPONDENTS.

Communications received from L. M'L.—R. H.—M. N.—B.—B. R. D. R.—J. D. C.—J. W. R.—G. M.—Leonce.—A. Z.

A Mechanic may rest assured, that, in whatever style his communication may be written, it will be acceptable; if he is only careful in noting down the particulars of his invention, so as to be understood we have no doubt but we will be able to explain it to his satisfaction. We will call, however, as he requests, and see the Machine in operation.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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THE GLASGOW
MECHANICS' MAGAZINE,

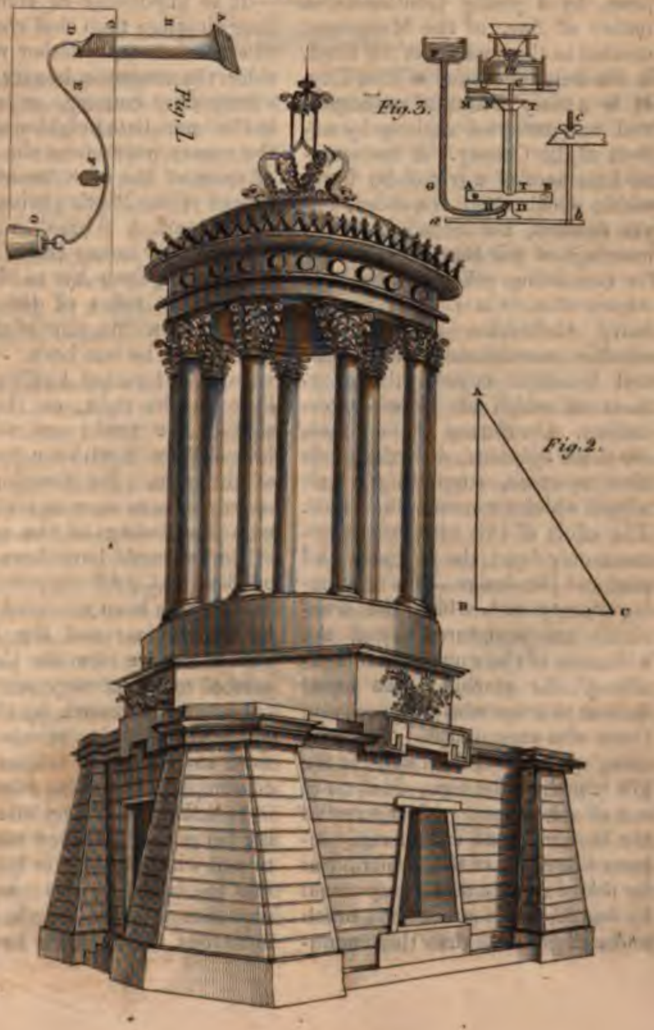
CONDUCTED BY

A Committee of Civil Engineers and Practical Mechanics.

> "I thought of Chatterton, the wondrous boy,
> The sleepless soul, who perished in his pride,
> Of *Him* who walked in glory and in joy,
> Behind his plough, upon the mountain side.
> We Poets, in our youth, begin in gladness,
> But thereof comes in the end despondency and madness."

No. LVII. *Saturday, 29th January,* 1825. Price 3*d*.

MONUMENT ERECTED AT AYR, TO THE MEMORY OF BURNS; DR. BARKER'S MILL, &c. &c.



— Swan Sc. —

MONUMENT ERECTED TO THE MEMORY OF BURNS,

NEAR AYR.

Last Monday was the Anniversary of the birth-day of Robert Burns; we have therefore thought proper, (and we do not think it requires any apology,) to present our readers with the accompanying beautiful engraving by our townsman Swan, from an accurate drawing, taken expressly for the purpose, by a young Gentleman, a native of Ayr, of the Monument erected to the memory of the Bard, in the neighbourhood of that City. It is a very beautiful structure, and was executed entirely by natives of the County. It has a rustic basement of a triangular form, within which there is a room, not yet finished, but intended for the meetings of the Burns' Club, and for containing relics of the Bard. Above this, is a circular row of fluted Corinthian pillars, 9 in number, surmounted by a light and beautiful cupola, the ornaments of which are likewise Corinthian. On the top of the cupola are three dolphins, with their tails bent upwards, supporting a gilt tripod, which surmounts the whole. The effect of this structure is uncommonly fine: the elegance and purity of the design,—the surpassing beauty with which the ornaments are sculptured,—and the whiteness of the stone, which looks almost like marble, does equal honour to those who designed, and those who executed it. The only thing we can find fault with, is the gilt tripod on the top. It is quite out of accordance with the rest of the building, and considerably injures the effect of that which, but for this, we might almost say would be faultless. It is certainly much to be regretted, that this monument is not entirely finished; neither the room in the basement compartment, nor the inclosure round it, which is intended to be surrounded with an iron railing, and planted with trees and shrubs, are completed; but we are glad to hear that this is likely soon to be done.

It is impossible to conceive a finer situation than that chosen for this monument, whether we consider the romantic beauty of the surrounding country, or its being in the immediate neighbourhood of the scenes which form the subject of some of the most beautiful effusions of the Poet's genius. It is situated on a "brae" near the "banks" of "bonny Doon," on the road leading from Ayr to Maybole, within two miles of the former town, and within view of the Cottage where he was born. "Allowa's auld haunted kirk" stands a little to the right, on the other side of the road; and the auld brig o' Doon is within a few yards of the spot. No situation more appropriate, or more in accordance with the feelings of the admirers of Burns, could have been selected than this. All the surrounding scenery has been rendered classic by his genius; and the feelings with which we view the Cenotaph erected to his memory, are heightened, and increased, by the contemplation of the scenes which were so much the subject of his contemplation and his admiration.

In talking of Burns after praising his genius, it is too customary to end with allusions to his follies. We too could do this: we could expatiate at great length, on the numerous follies which have been

attributed to him; but we would rather contemplate his many virtues. His noble independence, his enlarged and liberal views, his contempt of every thing mean and base, his warm, affectionate, and generous disposition, are much more worthy of our notice, than the frailties and the follies with which obloquy loves to heap his name. Man is prone to error; and amid the blaze of his genius and his fame, Burns yielded to passions, and propensities, which it would have been well he could have withstood: but when we consider his hapless fate, and premature death, it is for us to draw a veil over his errors; and whilst we do so, to drop a tear over the remembrance of his misfortunes.

Dr. BARKER'S MILL.

[Having been requested by several Correspondents to give a Drawing and description of the Machine known by the name of Barker's Mill, we now take an opportunity of doing so.—M. N. says that a friend of his has made great improvements on this Machine: we would be obliged by his sending us a drawing and description of them.]

The first mills which were driven by the reaction of water were called Barker's Mill, and sometimes Parent's Mill. We are not acquainted with the nature of M. Parent's claim to the invention: nor can we determine whether the priority is due to him or to Dr. Barker. Dr. Desaguliers, who seems to have been the first person who published an account of the machine, describes it as having been invented by Dr. Barker. "Sir George Saville says, he had a mill in Lincolnshire to grind corn, which took up so much water to work it, that it sunk his ponds visibly, for which reason he could not have constant work; but now, by Dr. Barker's improvement, the waste water only from Sir George's ponds keeps it constantly to work."

Dr. Barker's mill is shewn in Fig. 3, where $C\,D$ is a vertical axis, moving on a pivot at D, and carrying the upper millstone m, after passing through an opening in the fixed millstone C. Upon this axis is fixed a vertical tube $T\,T$ communicating with a horizontal tube $A\,B$, at the extremities of which $A\,B$ are two apertures in opposite directions. When water from the mill-course $M\,N$ is introduced into the tube $T\,T$, it flows out of the apertures $A\,B$, and by the reaction or counter-pressure of the issuing water the arm $A\,B$, and consequently the whole machine, is put in motion. The bridge-tree $a\,b$ is elevated or depressed by turning the nut c at the end of the lever $c\,b$. In order to understand how this motion is produced, let us suppose both the apertures shut, and the tube $T\,T$ filled with water up to T. The apertures $A\,B$ which are shut up, will be pressed outwards by a force equal to the weight of a column of water whose height is $T\,T$, and whose area is the area of the apertures. Every part of the tube $A\,B$ sustains a similar pressure; but as these pressures are balanced by equal and opposite pressures, the arm $A\,B$ is at

rest. By opening the aperture at *A*, however, the pressure at that place is removed, and consequently the arm is carried round by a pressure equal to that of a column *T T*, acting upon an area equal to that of the aperture *A*. The same thing happens on the arm *T B*; and these two pressures drive the arm *A B* round in the same direction. This machine may evidently be applied to drive any kind of machinery, by fixing a wheel upon the vertical axis *C D*.

ANSWER TO QUESTION—No. 4, P. 104, Vol. II.

Construct a right angled triangle A B C, (see Fig. 2d,) right angled at B, and having one of its acute angles B A C, 23°. If A B, be supposed to be drawn perpendicular to the horizon, it will represent the position of the string when the body, which it suspends, is allowed to hang freely. A C will represent its position when the body is pushed aside so as that the string shall make with its former position, an angle of 23°, and if the body be pushed aside by a force exerted in a direction parallel to the horizon, the direction of that force will be represented by the line B C. When the string assumes the position A C, it is evident that the body is kept at rest by three forces, viz: the force of gravity, or the weight of the body, acting in a direction parallel to A B; the force exerted to push the body aside, acting in the direction B C, and the force exerted by the string, in the derection C A. Therefore, as A B, is to B C, or, which is the same, as Radius is to the tangent of the angle B A C, so is the weight of the body, to the force that is requisite to push it aside so as to make the string assume the position A C. Hence,

As Radius	10.00000
Is to tangent 23°	9,62785
So is 3 cwt.	0,47712
To 1,273 cwt.	0,10497

Whence it appears, that a force equivalent to 1,273 cwt., is requisite to push the body aside according to the conditions of the query.

ACCOUNT OF THE ERECTION OF THE BELL-ROCK LIGHT-HOUSE.

(Continued from p. 425, *Vol.* II.*)*

In the Spring of 1809 the operations recommenced; and the building, during the course of this season, advanced with great rapidity. The winter storm had done no injury; the whole of the courses which had been laid, and the Beacon itself, was, in the third year from its erection, remaining quite secure. The artificers, from this tried stability of the Beacon-house, were rendered more confident, and more impatient of the trouble and inconvenience attending landing and re-landing on the rock from the tender: and, therefore, before it was quite fitted up for a barracks, they took possession of it through the day. One evening, however, a gale of wind prevented the boats from taking them off. Mr. Peter Logan, and

Mr. Francis Watt, two of the overseers at the rock, with eleven of the artificers, were necessarily left there for 30 hours, while very often the waves washed over their yet imperfectly formed abode: the mortar gallery below them, was carried away by the violence of the storm, and one of the cranes was broken to pieces. Hitherto the operations of the builders were wholly confined to the low-water work. From the great exertions, however, made by the shipping department in supplying materials this season, the builders were enabled to lay 30 blocks of stone in the course of a tide.

When the building had attained the height of the ninth course, the guy ropes of the usual description of beam crane, became too upright, and it was found necessary to resort to other measures. A new machine, called a Balance Crane, was therefore put in preparation for the use of the works next season. In this, the upright shaft was to be retained in an erect position, by a weight acting on the opposite end of the loaded beam, which was thus to be kept *in equilibrio*.

The Light-house now began to appear considerably above the rock at low-water; and the tide's work, in moderate weather, extended to 5 or 6 hours, or an hour or two after the rock was under water. The Beacon-house was now fully occupied as a barrack, smithy, and mortar gallery; and between this fabric and the rising walls of the Light-house, a rope ladder of communication was distended.

Upon Sunday, the 20th of August, this year, the entire twenty-second course of the building, consisting of 51 blocks, was laid; after which, for the first time, prayers were read in the Beacon-house, the whole workmen being assembled in one apartment, and two of them joining hands to form a desk to support the Bible during the service. On the 25th of this month, the building operations were brought to a conclusion for the season.

At the commencement of the works in Spring, 1810, a great stock of prepared materials was in readiness at Arbroath, excellent sand-stone having been procured from Milnefield Quarry, on the Firth of Tay. The stones for the cornice and Light-house, which were from Craigleith, near Edinburgh, were likewise prepared, and in readiness for shipping at Leith. A large gangway or bridge of timber had been prepared during the winter, to render the communication between the Beacon-house and Light-house more perfect, than by means of the rope ladder; and which was calculated to be of great use for raising the materials upon the building.

The first circumstance attended to, in commencing the operations of this season, was to fix upon the proper situation for the door of the Light-house; and the heaviest seas being determined to be from the North-east, the door was laid off towards the South-west. The first cargo of stones was brought to the Rock about the middle of May; and from the very complete and systematic arrangement of the works, the building operations were brought to a close during the month of August, without any material obstacle having been experienced. This increased facility in building was ascribed partly to the experience acquired by practice during former seasons, and partly to the admirable adaptation

of the Balance Crane, formerly mentioned, for laying the stones on their places upon the building. The works were, however, occasionally interrupted, by the shipping being dispersed in gales of wind, when they were sometimes driven upwards of forty miles from their station. At such times, the artificers were closely cooped up in their barrack upon the rock, in a state of painful inactivity, and often with prospects very forlorn. It is certainly not a little remarkable, that in the course of their extensive operations, not a single stone was lost, or even so damaged as to be rendered unfit for the building, notwithstanding the numerous changes and shiftings from hand to hand, which each stone underwent before it was finally laid with mortar. In some instances, indeed, blocks of stone were lifted from their beds by the run of the sea; but none were carried entirely away.

In the plate to No. 55, we have given an elevation, and a section of the Light-house, to which we refer our readers. The lower courses of stones were trenailed and wedged together with oak timber to the height of upwards of forty feet, or throughout the solid part of the building. At the stone staircase, leading from the door to the first floor, the walls are of the medium thickness of about seven feet; this thickness gradually diminishes upwards, till, under the cornice of the building, it extends only to 18 inches. The stones of the walls of the several apartments are connected at the ends with dove-tail joints, instead of square joggles, as in the solid, and in the staircase. The floors are constructed in a manner which adds much to the bond or union of the fabric. Instead of being arched, which would have given a tendency or pressure outwards, on the walls, the floors are formed of long stones, radiating from the centre of the respective apartments, and at the same time, forming a course of the outward wall of the building; these floor stones are also joggled sidewise, and, upon the whole, form a complete girth at each storey. In this manner, the pressure of the floors upon the walls is rendered perpendicular, while the side joggles resemble the *grove and feather* in carpentry. In the stranger's room, or library, the roof takes an arched form, but the curve is cut only upon the interior ends of the stones of the cornice, the several courses of which it is composed being all laid upon level beds. Towards the latter end of August, the masonry was completed, and the operations of erecting the Light-room commenced. The beacon-house, which had hitherto been crowded by more than 30 persons, during the summer, was now more thinly peopled. Toward the end of the month of October, the balance crane, and the bridge of communication were dismantled; the former was no longer necessary, and in place of the latter the rope ladder was again distended; the Beacon-house being still occupied as the place of accommodation for the artificers employed in fitting up the Light-roof, and reflecting apparatus. In the month of December the keepers took possession of the Light-house: about the middle of that month, the whole apparatus and stores, having been safely landed and lodged in the house, the light was advertised for exhibition on the 1st of Feb. 1811. On the afternoon of that day, it was

accordingly exhibited; and the floating light was extinguished, as being no longer necessary. Since the completion of the Light-house, the Beacon-house has been removed, and also part of the iron railways, leaving only such tracks of them upon the rock, as were thought necessary for landing the stores, and communicating with the Light-house. Instead of a rope ladder, the communication between the rock and the entrance door, a height of about 30 feet, is now formed by a brazen stair, which answers also for part of a thunder rod, and facilitates the raising of the stair, by a peculiar sort of crane adapted to the purpose. The fortunate position of the entrance door rendering it seldom necessary to shut it in summer, an inner door of brass has been hung, which is found to be a great conveniency to the inmates. During storms, when their double doors, double windows, and storm shutters, are closed, the Light-keepers mention that they occasionally feel a tremor in the building, from the shocks of the sea, but that all is quiet within, and they hear nothing of the dashing and roaring noise of the sea.

WATER TRAPS, TO PREVENT SMELL FROM COMMON SEWERS.

To the Editors of the

GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—The author of the paper entitled "A plan of a Water-trap to prevent the Stench arising through the Gratings of the Common Sewers," seems fully aware of the importance of the subject—only so far, however, as it is disagreeable to the senses. He has never mentioned how much more healthy it would be, not only to those who reside near it, but to the public at large. How many valuable lives might be annually saved in Glasgow alone, if the plan which he has proposed—the one which I have to propose—or some one similar, were to be adopted. The importance of the subject speaks for itself, and I am surprised that it has never been proposed by some Society of Arts, or Board for the Management of Public Health, as a subject for a prize essay.

The plan of your Correspondent is obviously objectionable. If nothing but pure distilled water were to run through it, it would do; but, as all the filth of the streets and closses are washed into it, the pit C would soon fill; and, after it was full, it would not act. Besides, the upright tube A would gradually fill after the pit C; and, instead of removing a nuisance, it would create one.

The plan I propose is as follows: A, (fig. 1,) is a grating that should be fitted to the tube B by a hinge, that it may be lifted for cleaning or repair. The tube B should have a gradual curve from the edge of the grating A to the proper width of the tube B. The weight of the water should stand in the tube B about the height C, that it may act more completely as a valve. The tube B should terminate at an angle of about 25° or 30°, that the filth may go into the common sewer more easily, being favoured by the inclined plane and its own gravity. The valve D should be fitted accurately to the tube B, so that the water may not be allowed to get into the sewer—and of course the air from the latter—keeping it always at a certain height. The valve D is rivetted to the lever E. The fulcrum F may go from side to side

of the sewer, and the lever may play on it at any given point, according to the quantity of water that usually runs in it, or to the weight G at the other end. The whole accuracy of the instrument depends on the weight G, and the length of lever at that end being so proportioned that it may keep the valve D shut, so that the water C stand always at a certain height in the tube B;—care being taken that a gush or weight of water falling may not so put it off the balance that it all escape. The reason of the bend below the valve D is, that straw, and other gross filth, may not accumulate too near it. A foot of water in the tube should at least be allowed. The weight G, instead of hanging, may be fixed above, so as not to encroach on the sewer. This, or some other, deserves a trial, as it is a subject of importance to all ranks of society.

S.

[The plan now inserted, we think iable to all the objections urged against our plan, and to many others besides. It is much more complicated, will be much more expensive, much more liable to choke up, and, from its complicated nature, it will be very difficult to keep it in order. We have given it, however, because we think the subject one of importance, and wish it to be as much as possible before the public eye. We would be glad to see some plan adopted; and our own is undoubtedly the simplest and least expensive, while at the same time we suspect it will be as effectual as any which can be adopted. We think that the weight of the water falling into the pit C, (see Number LIII. Vol. II.) which would of course have a curved bottom, would keep it sufficiently clean; but, were any doubts entertained on this point, a small sluice could be added to the side of the pit C, and, in case of the pit filling, this sluice could be pulled up by a rod put down through the grating above, and the whole sludge, or filth, would then be sent down into the sewer.]

ON SIR HUMPHREY DAVY'S PLAN FOR PROTECTING THE COPPER OF SHIPS.

A scientific investigation has rarely excited more public attention and interest than that which relates to the protection of the copper of ships by the contact of some *positive* metal; this is not surprising when we consider the great national importance of the object, and the very striking manner in which an apparently abstract principle of philosophy has been brought into immediate practical application, by the most simple process of art. We have lately observed several paragraphs in the public prints, which contain representations calculated to render the public less sanguine as to the ultimate success of Sir H. Davy's plan.—We are, however, enabled to state, that the first accounts given of the condition of the *Samarang's* copper is entirely unfounded, and the subsequent one very incorrect. The copper of this ship had been on between three and four years, and she was chosen for the particular purpose of ascertaining the effects of the principle of protection in *old* copper, and we know that the result has more than answered the expectations of the inventor; for, as she appeared in dock, her copper might be considered as absolutely clean, and it required minute examination to discover the few capillary weeds and shells adhering, *not to the protectors*, but to the oxide of iron, for a small space round them on the stern. Both as to cleanness, and as to the effects of rapid corrosion, the experiment was perfectly successful. We are acquainted with another example in the yacht of a distinguished nobleman which, was protected in May last, and taken on shore a

few weeks ago, and found perfectly clean, and the copper almost unchanged. The only vessel, the *Arethusa*, which has been under the influence of protectors, for any considerable length of time in Plymouth Harbour, is said also to be in a very satisfactory state. We have moreover just received intelligence from Naples of the arrival of the *Seringapatam*, another protected ship, and that she has entered the Bay, with her copper beautifully bright. These few instances are sufficient to show that the method of protecting copper, as proposed by Sir H. Davy, promises to answer the intended purpose; but, even, if in some instances foulness has been, or shall be produced by excess of protection, it will only demonstrate the power of the principle of protection, which may be so graduated as to save all the copper, or 1-10th, or 1-5th, or 1-3d, of any other proportion. The practical application of this principle can only be learnt by varied experiments, which we feel confident the genius of the inventor will establish. He is, we understand, at present engaged in ascertaining whether the best results are to be obtained by a few large, or by numerous such protectors placed below or above the copper; and also all the circumstances of the corrosion of *different kinds* of copper by sea-water. We have offered these remarks, derived from authentic sources, as an act of justice to the labours of Sir Humphry Davy. It must be highly painful to the Learned President, to find incompetent persons reasoning upon experiments which they cannot understand, and questioning results which they cannot fairly appreciate. To the Public it must be annoying to read so many contradictory statements and misrepresentations; to Science it is humiliating, for it proves that, like commerce or politics, she even is exposed to the jealousies of conflicting interests.

CURIOUS PHENOMENA OBSERVED IN THE MINES IN DERBYSHIRE.

To the Editors of the
GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—On Wednesday the 12th instant, I attended the lecture given by Dr. Ure in Anderson's Institution, for the Mechanics' Class, the proceeds of which are to go to the subscription for raising a monument to the memory of the celebrated James Watt. Among the great variety of mechanical and chemical experiments exhibited that night, there was one on Iodine, which struck me forcibly by its violent explosion. The Doctor, who is I believe the largest manufacturer of this article in the world, described its appearance as very much resembling powdered steel or black-lead. My object in mentioning this circumstance is to draw the attention of some of your chemical correspondents to the solution of a strange and unaccounted-for natural phenomenon.

In the Haycliff and Ladywash mines in the Peak of Derby, the miners come to a vein of ore composed of copper, lead, zinc, and siliceous spar, which has the singular appearance of having been run with a plane, for the prominences of the one side exactly fit the hollows in the other, as neatly and closely as two pieces of wood could be joined together, and the surfaces of these fluted planes are smooth and shining, as if rubbed over with black-lead, or some substance very much resembling *iodine*. When the miners fall in with these veins, they all retire to a place of safety but one man, who draws a sharp pointed pick up and down to scratch the face of it: he, too, instantly retires to a distance, and hears something like the beating of a church clock, and immediately after an explosion takes place, and the vein is shattered to pieces and thrown out in great quantities.—

The miners avail themselves of this fact, and have brought down as many minerals at one explosion, as ten men could do in three months. There is an extrication of some elastic fluid at the time of explosion, for the bucket hanging over the pit has been lifted up, though of considerable weight, and the stemples, or planks laid across fissures in the mine, have been torn or split in pieces, and it also produces the same shaking as an earthquake.—Can this blacklead appearance of the surface of these singular veins, be iodine? Or is it a galvanic or an electrical power that produces such wonderful effects? It would appear that the surface of these veins is in the same state with the glass tears called prince Rupert's drops, which, when scratched or broken, fly in pieces with great violence, from the repulsion of their particles to one another.

A full account of these mines, and of this phenomenon, may be seen in the appendix to Whitehurst's Enquiry into the Original State and Formation of the Earth; Lond. 1778. If some of your ingenious Correspondents could throw any light on this hitherto inexplicable phenomenon, it would greatly oblige, your's, &c.

J. P.

Glasgow, 22d Jan. 1825.

PROFESSOR ANDERSON AND DR. BIRBECK.

To the Editors of the
Glasgow Mechanics' Magazine.

Gentlemen,—A paper, signed W. G. having appeared in one of your late Numbers, and your Correspondent B. having disapproved of parts of it, he replied; and, to establish an opinion that he had formed, along with others as ignorant of the subject as himself, he brought forward a transaction which took place in Anderson's Institution, in which my name is mentioned, along with Mr. Watt's, as having come forward and read the Will of Professor Anderson to the Class; and again, in his answers to the friends of W. G., he says—" Does Aliquis mean that the aged Messrs. Black & Robertson palmed a deliberate falsehood on the Class, when they affirmed that they were the agents through which Dr. B. formed the Mechanics' Class? Did Messrs. Hart & Watt falsify Professor Anderson's will, or was it through ignorance that they and the Committee joined in misleading the Class, as to its tenor? Did Dr. Ure falsify the sederunt book, or was it from ignorance that he gave a similar opinion on its contents? And, lastly, did Dr. Ure, the Committee, and the five hundred subscribers to the address, prepare and subscribe that paper either wittingly or ignorantly, containing what was not the fact? It is for your Correspondents to take which horn of the dilemma they choose.—To me it is a matter of indifference."

Perhaps, my best way to answer this, is to give a statement of what took place, so far as I was concerned.

The Class proposed to get some memorial of Dr. Birbeck, in order to establish their priority to any other Class of the kind, conceiving Dr. Birbeck to be the founder of it. A Committee was named, of which I was a member, who were to get the business set a-going, and to give the Class an idea of how the Professor left the Institution.

The abridged printed copy of his will was handed to me by some one of the Book Committee, and, at same time, we were told by Mr. Warren, that we were to act just as we were instructed by the Class, and not to use our own opinion in any thing. We accordingly read all that was pointed out, and all that appeared to us to bear on the subject; and left the Class to make of it what they thought best. This seems the part that Mr. Barclay alludes to, in which I was a party. As to what Messrs. Black & Robertson informed the Class of, it was merely this: that they waited on Dr. Birbeck about some business of their own, and at that time he informed them that he was going to give a few lectures gratuitous, and gave them each a ticket and a few hand-bills to distribute.

Any other information that the Committee acquired was from the Class.

As to the part the Convener of the Committee took, (that is, Dr. Ure,) he acted, as far as I saw, according to the sederunt book, and to the will of the Class. I do think that he wished the Class to follow their own judgment, not his. They did so, and Dr. Birbeck was written to. He returned no answer; —he was written to again. The Class waited about THREE MONTHS and no answer was received. Dr. Ure then wrote to a friend of his own, Dr. Moir, requesting him to call on Dr. Birbeck. He did so, and found him in possesion of both the letters. There is something unaccountable in this: it looks as if Dr. Birbeck saw the sandy foundation on which his honours were to be built. He got over this, however, by desiring Dr. Moir to write an apology for him, as he had not time himself!!! This, in course of post, we received from Dr. Moir; and, at same time, we received a letter from Dr. Birbeck, apologizing in a very lame manner to the Committee; and on the same sheet, a letter to be read to the Class, stating his readiness to sit for his Portrait. This letter, he says, he wrote on second thought, after Dr. Moir had left him. The Committee not agreeing with the Class about the Painter, the Committee resigned, and here my part of the business ended. Had it been known to me at that time, that Professor Anderson had carried on in the College, a Class which he used to denominate his *Antitoga Class*, to which work people were allowed and invited by him to attend; I certainly would have stated it to the Class; as when this circumstance is known, his intentions are apparent to every one who reads the will carefully, to have been to give knowledge to those who were, before his time, shut out from science. His able Successor in the College, who was his assistant Lecturer before his death, still follows his example of admitting a separate Class of Students to the experimental part of his Course. I suppose, by this time, Mr. Barclay is convinced, as well as I am, that we were all led in the dark, to give the honour to *whom it was not due;* and since it is justice, and not controversy that we are after, let us drop all party spirit, and give the honours to the first who opened the door of science, and invited in Mechanics; and who, at his death, left his property for their further instruction. Your's, &c.

ROBERT HART.

To the Editors of the
GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—I observe that my opponent B. has come forth as Mr. Hugh Barclay, and with all the characteristic quibbling of the profession to which he belongs. Some may think him a more formidable opponent in this shape, but I consider the "adhibiting" of his name to be merely an easy way of getting rid of that which he finds himself incompetent to support.

In answer to his sweeping assertion, that nothing advanced by him has been contradicted, I beg leave to say to him, that *I now contradict all the assertions he made with regard to Dr. Birbeck being the first who opened a Class for Mechanics*, and I refer him to my former letter for the proof in support of this contradiction.

As to what was said and done by Dr. Ure, Messrs. Hart, Watt, Black, and Robertson, I leave them to discuss the matter with Mr. Barclay as they please; I have nothing to do with it: the argument upon which Mr. B. and I are at issue, is not what then occurred, but this, "Whether to Pofessor Anderson or to Dr. Birbeck may be traced the origin of Mechanics' Institutions?" Mr. B. has *asserted*, that it may be traced to the latter, and I have *proved*, that with the former Gentleman they had their origin; and *that proof* Mr. B. has not *attempted* to invalidate. When he replies to the facts in my last, I shall be ready to meet him, but I decline leaving this subject even at his request.

As to his mysterious threatening, I do not mind it; "facts are chiels that wunna ding;" and if he doubts what I have asserted to be true, he can read Dr. Birbeck's letter of resignation, which may perhaps satisfy him. An account of Anderson's Institution, to be found in a contemporary Magazine, will also bear me out in my assertions, "that when the Dr. was told that he would have to run the risk of the class paying him—he resigned:" the reason of this is well known.

As I have no interest to serve, by giving my name as Mr. Barclay has done, I shall still appear in the character of

ALIQUIS.

RAMAGE'S TELESCOPE.

M. Dupin and Dr. Gregory, during an excursion in Scotland, were much delighted with the excellence of the instruments made by Mr. John Ramage, of Aberdeen, and their facility of use, and valuable observations of the Heavens, worthy of an observatory of the first order. They were astonished to find such inventive talents and knowledge in a humble tradesman, who devotes the leisure hours, spared from his business, to scientific pursuits, whose knowledge and genius are only excelled by his great modesty, and readiness to oblige.

One of these telescopes is placed at Broadford, near Aberdeen, in the grounds of Dr. Dauney, the professor of law. The tube is twenty-five feet long, and its diameter eighteen inches. At the bottom of the tube, when the telescope is to be used, is placed a metallic speculum, finely polished, of fifteen inches diameter.—From this speculum a fine bright and clearly defined image of the body observed is reflected: and as an eye-piece of only a small magnifying power is required; there is as pleasant and distinct a view as if the object was seen by the eye.—The superior view of the Heavens as seen by such an instrument, can be appreciated by those only who have enjoyed the advantage of an observation with it. To produce any considerable power upon a small telescope, deep magnifying eye-glasses must be used, consequently, the field of view is much contracted, and there being but little light, the object is seen very unsatisfactorily. But with the large reflecting telescope the observation is one continued source of unmixed pleasure. Mr. Ramage's telescope is erected on a cast iron platform, twenty-seven feet in diameter, on piles jointed, and dove-tailed together. The whole was placed in a horizontal position by means of a spirit level. The centre post is about four feet deep. The telescope is moved round to any

direction, on cast iron rollers, by a winch at the end, near the lower part of the tube, and a rope. The tube of the telescope is raised to any altitude by the winch on the one side. When it is desired to be elevated to the zenith, or to any high elevation, the end of the tube is brought forward; the gallery on which the observer stands, is raised by a similar winch on the opposite side. All the motions of the telescope are produced in the simplest manner by means of a few cords: yet the telescope is perfectly steady, and free from tremor, and may be managed by the observer without an assistant, almost as easily as a three feet achromatic telescope. This is a decided advantage, as the observer can place the tube in the most favourable position for vision, better than any assistant. When the observer is in the gallery he is able to keep the object a long time in view, as the telescope may sweep backwards and forwards 10°, and the observer may elevate or depress it, and himself, with one hand. The machinery of Herschel's twenty-feet telescope is very complicated, and requires two assistants. Mr. Ramage is now engaged in preparing a grand telescope, of which the speculum is fifty-four feet in length, and twenty-one inches diameter. The casting and polishing of the specula and erection of the telescopes are done under his direction, and in a great degree with his own hands. The excellence and simplicity of management, alike entitle the instruments to admiration.

SLEEP *v.* STUDY.

Gentlemen,—Of all known hostilities, *few* perhaps are of longer standing than that between *Sleep* and *Study.*—Study may, indeed, boast of no small exploits and achievements; yet *sleep*, we find, most commonly gains the *day*. For our own part, we were lately in a great dilemma. To study during the day was incompatible with our avocation, and at night we no sooner took up a book, than sleep began to weigh our eyelids down, as if determined to bar out knowledge. Thus enslaved, we summoned our whole powers,—made several attacks upon the foe, but to little avail.

At length, however, we procured a common *onion*—cut it through the middle—and brought *it* and *our eyes* into close contact. This contact caused not bloodshed but *brineshed;* it mollified our visual eye-balls, and left *ourself* perfectly collected! By this simple means, in short, we keep the *drowsy god* at bay, every night, till we hear the iron tongue of midnight. Wherefore, knowing ourself to be not *alone* engaged in this nocturnal war, and you to be a proved champion for literature and learning, we deemed it proper to tender this capital recipe to the Public.

I am, Gentlemen, &c.

L. M'L.

Coll, January, 1825.

THE BEST CHRONOMETER.

The Lords Commissioners of the Admiralty having advertised a premium of £300 for the best chronometer, which should be kept at Greenwich for trial, for one year; thirty-six were sent thither, by the principal chronometer-makers in London, and were kept in 1823. It was announced, that if any chronometer varied six seconds, it could not obtain the prize. At the end of the year, the prize was decided to be gained by chronometer, No. 816, made by Mr. James Murray, of Cornhill, whose instrument, on no one month, varied more than one second and eleven hundredth parts of a second. This distinguished artist, who had the honour of producing the best instrument ever known, is a native of Moffat, in Dumfriesshire. The chronometer is now sent out with Captain Parry. The second best chronometer, of which the variation was about five seconds, was made by Mr. Cathro, a native of Dundee. Thus, both the prizes were gained by Scotchmen. Such perfection was never before attained, and it justly excited the astonishment of all astronomers, and of the Board of Admiralty.

VOLTAIC-MECHANIC AGENT.

In the first Number of this work, [No. 53,] which came forth under our superintendence, it fell to our lot, to make some observations on the Editor of the Chemist, and as to his having appropriated to himself a discovery which had been made by one of our Correspondents, and which had been published in this Magazine about a month previous to the time it appeared in the Chemist. We are glad now to be able to state that the Editor of the Chemist has at once given to our Correspondent, the honour to which he is entitled of having discovered this new Agent before him, at any rate; but we certainly do not like well the observations with which his admissions are coupled. He talks of his having been informed, that the same idea had occurred to a Gentleman in London, and seems to wish to give the merit of the discovery to this unknown. If he had looked carefully over our Correspondent's Letter, he would have seen that the idea had occurred long ago to him, and that it was not recently formed. There can be little question, therefore, that he is the first discoverer of this new Agent, whatever may turn out to be its utility, of which, however, we have already expressed our doubts. We have further to object to the Editor of the Chemist, saying, that he claims the merit of, like our Correspondent, blundering on a discovery: He may have blundered upon it; but he certainly has no right to lower the merits of others, or to attribute that to chance blundering, which for any thing he knows to the contrary, may have been the consequence of much ingenious speculation and experiment. As he has, however, denied ever having seen the No. of our work in which the discovery is mentioned, we at once free him from any suspicion, which the oddness of the circumstance of his "blundering" on a discovery, a few weeks after we had given forth that discovery to the world, may have created. We quote the article from the 45th No. of the Chemist, in which the claims of our Correspondent are admitted.

"We had no intention of again adverting to this subject at present; but we are in some measure compelled. An ingenious friend has drawn our attention to No. 51 of the Glasgow Mechanics' Magazine, in which we are indirectly accused of having appropriated to ourselves the invention of another. On turning to No. 43 of this work, published on October 23, in which this invention is recorded, we found the following article." Here the Chemist quotes the article from our Magazine, No. 51, to which we refer the reader.

DYEING WOOD.

General Observations.

It being necessary to say something as to the quality, nature, and texture of the wood most fit for dyeing, I shall state my remarks in the following order:

First, the wood mostly used to dye black, is pear-tree, holly, and beech, all of which will take a beautiful black; it should at the same time be observed, not to take wood which has been long cut, or aged, but as fresh as possible: I have likewise found, that after the veneers have had one hour's boiling, and taken out to cool, that the colour

has struck much stronger. It should likewise be noticed, that after the veneers are dyed, they should be dried in the air, and not by the fire, or in a kiln of any kind; as it tends to destroy the colour.

Secondly, in order to dye blue, green, red, or other colours, take clear holly; put the veneers first in a box or trough with clean water, and let them remain four or five days, changing the water once, or twice, as you find occasion; the water, acting as a purgative in the wood, will bring forth abundance of slime, &c.; let them dry about twelve hours before they are put in the dye; by observing this, you will find the colour strike quicker, and be of a brighter hue.

Fine Black.

Have a chair-maker's copper fixed, into which, put six pounds of chip logwood, and as many veneers as it will conveniently hold, without pressing too tight; fill it with water, and let it boil slowly for about three hours; then add half a pound of powdered verdigrise, half a pound of copperas, and four ounces of bruised nut galls, filling the copper up with vinegar as the water evaporates; let it boil gently two hours each day, till you find the wood to be dyed through; which, according to the kind, will be in more or less time.

Fine Blue.

Take a clean glass bottle, into which put one pound of oil of vitriol; then take four ounces of the best indigo, pounded in a mortar into small lumps; put them in the phial (take care to set the bottle in a basin or earthen glazed pan, as it will ferment); after it is quite dissolved, provide an earthen or wooden vessel, so constructed that it will conveniently hold the veneers you mean to dye; fill it rather more than one-third with water, into which pour as much of the vitriol and indigo (stirring it about), as will make a fine blue; which you may know by trying it with a piece of white paper or wood; put in your veneers, and let them remain till the dye has struck through.

Note.—The colour will be much better if the solution of indigo in vitriol is kept a few weeks before using it; also the best trough you can use, being either made of common stone, like a stone sink, but of proper dimensions, say about four feet by eight or nine inches, which will be sufficiently large for veneers intended to be stained; or you may procure one made of artificial stone of any dimension, which will not cost so much; also you will find the colour strike better if, previous to putting your veneers into the blue dye, you boil them in plain water till completely soaked through, and let them remain for a few hours to dry partially, previous to immersing them in the dye.

Fine Yellow.

Take of the root of barberry four pounds, reduce it, by sawing, to dust, which put in a copper or brass trough, add four ounces of turmerick, to which put four gallons of water, then put in as many white holly veneers as the liquor will cover; boil them together for three hours, often turning them; when cool, add two ounces of aqua-fortis, and you will find the dye strike through much sooner.

Bright Green.

Proceed as in either of the above receipts to produce a yellow; but instead of adding aqua-fortis, or the brightening liquid, add the vitriolated indigo, as much as will produce the desired colour.

Bright Red.

Take two pounds of genuine Brazil dust, add four gallons of water, put in as many veneers as the liquid will cover, boil them for three hours; then add two ounces of alum, and two ounces of aqua-fortis, and keep it luke-warm until it has struck through.

Purple.

Take two pounds of chip logwood and half a pound of Brazil dust, add four gallons of water, and after putting in your veneers, boil them well, for at least three hours; then add six ounces of pearl-ash and two ounces of alum, let them boil two or three hours every day, till you find the colour struck through.

Note.—The Brazil dust in this receipt is perhaps superfluous, as it only contributes to make the purple of a more red cast, for the pearl-ash does not act upon it to change it from a red to a purple.

Orange.

Let the veneers be dyed, by either of the methods given, of a fine deep yellow, and while they are still wet and saturated with the dye, transfer them to the bright red dye, till you find the colour has penetrated equally throughout.

SINGLE BARREL AIR-PUMP.

To the Editors of the
GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—A few readers of your Magazine in a Village in this Neighbourhood, have for the last ten months, met regularly once a-week, for the purpose of endeavouring to extend, by mutual instruction or conversation, their knowledge of Natural Philosophy, Chemistry, and other branches of Natural Science; and have, by small pecuniary contributions, furnished themselves with various useful articles of apparatus. They wish at present to add to their apparatus an air pump, and have desired me to ask the favour of your inserting in your Magazine, the query: For what sum would any of your Correspondents, who is acquainted with the construction of such instruments, furnish a small but effective single Barrel Air Pump, constructed on the plan described in the 32d number of your work?

I am, Gentlemen, &c.
J. W.

Moffat.

QUERIES.

1. I have observed that the walking-beams of almost all Steam Engines are made in the form of a curve. I should be very glad that any of your readers, through the medium of the Magazine, would inform me what advantage is derived by this shape of the walking-beam over those which form a straight line from the centre?—A. M WRIGHT.

2. The great proportion of casts of human heads are, more or less, distorted; from the softer parts of the face being compressed by the weight of the plaster, while the hard parts resist the pressure: Could any of the readers of the Mechanics' Magazine furnish a correct method of taking casts, by which this would be avoided?—R. W.

3. A Gallowgate enquirer wishes to know the properties of the water in the pump-well in Wilson-street. He has found when his butter, (for he is a dealer in butter,) in the summer months, becomes in any degree rancid, or as it is called, windy, or tasted,—the following recipe completely restores its sweetness. A pound of salt and an ounce of saltpetre, boiled in two pints of water. In the course of applying this specific, he has tried all the water about town,—common pipe water, different wells in town, Arns well, &c.; and has found none of them answer so well as the Wilson-street well. This is his reason for wishing to know the properties of that water.

NOTICES TO CORRESPONDENTS.

Communications have been received from A. B.—A Gallowgate Enquirer—D. M. B.—Donald Frazer—R. P.—A Friend and Mechanic will be attended to, when we reprint No. I. which must be done, for the *Fourth Time*, in a few weeks.—Mr. Williamson will oblige by sending the paper he offers, and also an account of the suggestion of Mr. Johnstone.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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"Unconquer'd powers, th' immortal mind display'd,
But worn with anxious thought the frame decay'd."

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SOME ACCOUNT OF THE CHARACTER AND MERITS

OF THE LATE

PROFESSOR PLAYFAIR.

HAVING now brought our Second Volume to a conclusion, we have thought proper to adorn it with a Portrait of the late Professor Playfair, of Edinburgh; and, as we believe it impossible to add any thing to the following eloquent character of him by Mr. Jeffrey, we have preferred quoting it, to giving any thing of our own:—

"It has struck many people, we believe, as very extraordinary, that so eminent a person as Mr. Playfair should have been allowed to sink into his grave in the midst of us, without calling forth almost so much as an attempt to commemorate his merit, even in a common newspaper; and that the death of a man so celebrated and beloved, and at the same time so closely connected with many who could well appreciate and suitably describe his excellencies, should be left to the brief and ordinary notice of the daily obituary. No event of the kind certainly ever excited more general sympathy; and no individual, we are persuaded, will be longer or more affectionately remembered by all the classes of his fellow-citizens: and yet it is to these very circumstances that we must look for an explanation of the apparent neglect with which his memory has been followed.

"We beg leave to assure our readers, that it is merely from an anxiety to do *something* to gratify this natural impatience, that we presume to enter at all upon a subject, to which we are perfectly aware that we are incapable of doing justice. For, of Mr. Playfair's scientific attainments—of his proficiency in those studies to which he was peculiarly devoted, we are but slenderly qualified to judge; but, we believe, we hazard nothing in saying that he was one of the most learned mathematicians of his age, and among the first, if not the very first, who introduced the beautiful discoveries of the later continental geometers to the knowledge of his countrymen, and gave their just and true place, in the scheme of European knowledge, to those important improvements by which the whole aspect of the abstract sciences has been renovated since the days of our illustrious Newton. If he did not signalize himself by any brilliant or original invention, he must at least be allowed to have been a most generous and

intelligent judge of the achievements of others, as well as the most eloquent expounder of that great and magnificent system of knowledge which has been gradually evolved by the successive labours of so many gifted individuals. He possessed, indeed, in the highest degree, all the characteristics both of a fine and a powerful understanding—at once penetrating and vigilant—but more distinguished, perhaps, for the caution and sureness of its march, than for the brilliancy or rapidity of its movements—and guided and adorned through all its progress by the most genuine enthusiasm for all that is grand, and the justest taste for all that is beautiful in the truth or the intellectual energy with which he was habitually conversant.

Mr. Playfair was not merely a teacher; and has fortunately left behind him a variety of works, from which other generations may be enabled to judge of some of those qualifications which so powerfully recommended and endeared him to his contemporaries. It is, perhaps, to be regretted, that so much of his time, and so large a proportion of his publications, should have been devoted to the subjects of the Indian Astronomy, and the Huttonian Theory of the Earth. For, though nothing can be more beautiful or instructive than his speculations on those curious topics, it cannot be dissembled that their results are less conclusive and satisfactory than might have been desired; and that his doctrines, from the very nature of their subjects, are more questionable than, we believe, they could possibly have been on any other topic in the whole circle of the sciences. A juster estimate of Mr. Playfair's talent, and a truer picture of his genius and understanding, is to be found in his other writings; in the papers, both biographical and scientific, with which he has enriched the Transactions of our Royal Society;—his account of De Laplace, and other articles which he is said to have contributed to the Edinburgh Review—the Outlines of his Lectures on Natural Philosophy—and, above all, his Introductory Discourse to the Supplement to the Encyclopædia Britannica, with the final correction of which he was occupied up to the last moments that the progress of his disease allowed him to dedicate to any intellectual exertion.

"With reference to these works, we do not think we are influenced by any national, or other partiality, when we say that he was certainly one of the best writers of his age; and even that we do not now recollect any one of his contemporaries who was so great a master of composition. There is a certain mellowness and richness about his style, which adorns, without disguising the weight and nervousness, which is its other great characteristic—a sedate gracefulness and manly simplicity in the more level passages—and a mild majesty and considerate enthusiasm where he rises above them, of which we scarcely know where to find any other example. There is great equability, too, and sustained force, in every part of his writings. He never exhausts himself in flashes and epigrams, nor languishes into tameness or insipidity; at first sight you would say that plainness and good sense were the predominating qualities; but, by and by, this simplicity is enriched with the delicate and vivid colours of a fine imagination—the free and forcible touches of a powerful intellect—and the lights and shades of an unerring harmonizing taste. In comparing it with the styles of his most celebrated contemporaries, we would say that it was more purely and peculiarly a *written* style—and therefore rejected those ornaments that more properly belong to oratory. It had

no impetuosity, hurry, or vehemence—no bursts or sudden turns or abruptness, like that of Burke; and, though eminently smooth and melodious, it was not modulated to a uniform system of solemn declamation, like that of Johnson, nor spread out in the richer and more voluminous elocution of Stewart; nor still less broken into that patch-work of scholastic pedantry and conversational smartness which has found its admirers in Gibbon. It is a style, in short, of great freedom, force, and beauty; but the deliberate style of a man of thought and of learning; and neither that of a wit, throwing out his extempores with an affectation of careless grace—nor of a rhetorician, thinking more of his manner than his matter, and determined to be admired for his expression, whatever may be the fate of his sentiments.

"But we need dwell no longer on qualities that may be gathered hereafter from the works he has left behind him. They who lived with him mourn the most for those which will be traced in no such memorial; and prize, far above these talents which gained him his high name in philosophy, that personal character which endeared him to his friends, and shed a grace and a dignity over all the society in which he moved. The same admirable taste which is conspicuous in his writings, or rather the higher principles from which that taste was but an emanation, spread a similar charm over his whole life and conversation; and gave to the most learned philosopher of his day, the manners and deportment of the most perfect gentleman. Nor was this in him the result merely of good sense and good temper, assisted by an early familiarity with good company, and a consequent knowledge of his own place and that of all around him. His good breeding was of a higher descent; and his powers of pleasing rested on something better than mere companionable qualities. With the greatest kindness and generosity of nature, he united the most manly firmness—and the highest principles of hónour, and the most cheerful and social dispositions, with the gentlest and steadiest affections. Towards women he had always the most chivalrous feelings of regard and attention, and was, beyond almost all men, acceptable and agreeable in their society—though without the least levity or pretension unbecoming his age or condition. And such, indeed, was the fascination of the perfect simplicity and mildness of his manners, that the same tone or deportment seemed equally appropriate to all societies, and enabled him to delight the young and the gay with the same sort of conversation which instructed the learned and the grave. There never, indeed, was a man of learning and talent who appeared in society so perfectly free from all sorts of pretension or notion of his own importance, or so little solicitous to distinguish himself, or so sincerely willing to give place to every one else. Even upon subjects which he had thoroughly studied, he was never in the least impatient to speak, and spoke at all times without any tone of authority; while, so far from wishing to set off what he had to say by any brilliancy or emphasis of expression, it seemed generally as if he had tried to disguise the weight and originality of his thoughts under the plainest form of speech, and the most quiet and indifferent manner; so that the profoundest remarks and subtlest observations were often dropped, not only without any solicitude that their value should be observed, but without any apparent consciousness that they possessed any. Though the most social of human beings, and the most disposed to encourage and sympathize with the gaiety of others, his own spirits were in general rather cheerful than

gay, or at least never rose to any turbulence or tumult of merriment: and while he would listen with the kindest indulgence to the more extravagant sallies of his younger friends, and prompt them by the heartiest approbation, his own satisfaction might generally be traced in a slow and temperate smile, gradually mantling over his benevolent and intelligent features, and lighting up the countenance of the sage with the expression of the mildest and most gentle philanthropy. It was wonderful, indeed, considering the measure of his own intellect, and the rigid and undeviating propriety of his own conduct, how tolerant he was of the errors and defects of other men. He was too indulgent, in truth, and favourable to his friends—and made a kind and liberal allowance for the faults of all mankind—except only faults of baseness or of cruelty—against which he never failed to manifest the most open scorn and detestation. Independent, in short, of his high attainments, Mr. Playfair was one of the most amiable and estimable of men—delightful in his manners—inflexible in his principles—and generous in his affections, he had all that could charm in society, or attach in private: and, while his friends enjoyed the free and unstudied conversation of an easy and intelligent associate, they had at all times the proud and inward assurance that he was a being upon whose perfect honour and generosity they might rely with the most implicit confidence, in life and in death—and of whom it was equally impossible, that, under any circumstances, he should ever perform a mean, a selfish, or a *questionable* action, as that his body should cease to gravitate, or his soul to live!

"If we do not greatly deceive ourselves, there is nothing here of exaggeration or private feeling—and nothing with which an indifferent and honest chronicler would not concur. Nor is it altogether idle to have dwelt so long on the personal character of this distinguished individual; for we are ourselves persuaded, that this personal character has almost done as much for the cause of science and philosophy among us, as the great talents and attainments with which it was combined—and has contributed, in a very eminent degree, to give to the better society of this our city, that tone of intelligence and liberality by which it is honourably distinguished. It is not a little advantageous to philosophy that it is in fashion—and it is still more advantageous, perhaps, to the society which is led to confer on it this apparently trivial distinction. It is a great thing for the country at large—for its happiness, its prosperity, and its renown—that the upper and influencing part of its population should be made familiar, even in its untasked and social hours, with sound and liberal information, and be taught to respect those who have distinguished themselves by intellectual attainments. Nor is it, after all, a slight or despicable reward for a man of genius to be received with honour in the highest and most elegant society around him, and to receive in his living person that homage and applause which is too often reserved for his memory. Now, those desirable ends can never be effectually accomplished, unless the manners of our leading philosophers are agreeable, and their personal habits and dispositions engaging and amiable. From the time of Hume and Robertson, we have been fortunate in Edinburgh in possessing a succession of distinguished men, who have kept up this salutary connection between the learned and the fashionable world; but *there never*, perhaps, was any one who contributed so powerfully to *confirm and extend* it, and that in times when it was peculiarly difficult,

as the lamented individual of whom we are now speaking; and they who have had the most opportunity to observe how superior the society of Edinburgh is to that of most other places of the same size, and how much of that superiority is owing to the two aristocracies of rank and of letters —of both of which it happens to be the chief provincial seat—will be the best able to judge of the importance of the service he has thus rendered to its inhabitants, and through them, and by their example, to all the rest of the country."

DR. BARKER'S MILL.

To the Editors of the
Glasgow Mechanics' Magazine.

Gentlemen,—The following observations on Barker's Mill, I hope, will be found to be correct; and if so, they may lead to some practical improvements. The extremity of the horizontal pipe has, in some of these machines, been observed to move faster than the velocity with which the water issued out from the orifices; and this increased rapidity has been ascribed to the effect of the centrifugal force acquired by the water from the rotatory motion of the horizontal arm. But this increased velocity certainly depends on quite a different principle. Suppose that there is no resistance from the air, no friction, nor any inertia or centrifugal force,—then, when the machine begins to move, its motion will obviously be slow, but will gradually increase; and the water, attaining the circular motion of the machine, its re-action, or pressure, will remain the same as when the machine was stationary; this pressure, continuing constant, will act as a constant uniform force, and produce a uniformly accelerated motion, which will be proportional to the period of action. The velocity, under these circumstances, would therefore go on increasing to infinity. But from the mere inertia of the machine, this velocity would be limited, for the motion would become uniform when the momentum of rotation is equal to the momentum of the water; and when resistance from the air and friction are taken into account, this uniform motion will be considerably less. With respect to the centrifugal force, it appears to be obvious, that, as it is obtained at the expence of the pressure, it cannot affect the operation of the machine. As the rotatory inertia of the water in the horizontal arm occasions a considerable loss of power, the more this is diminished, the more will the effect of the machine be increased.

Might not a very effective steam-engine be constructed on the principle of Barker's Mill? The revolving arm might move in a vertical plane, enclosed in a shallow air-tight cylinder, kept constantly in a state of vacuum by means of several small condensers, acting in immediate succession. This engine would have very little friction; and steam, being so light, the rotatory inertia would be trifling, and there would be no loss of power from fly-wheels and cranks.

A. B.

Dollar, 29th Jan. 1825.

ON MR. HENRY BELL AND STEAM NAVIGATION.

WHEN we look around on the land of our birth, and behold the many incalculable benefits she has received from the aid of machinery; the power and influence which she has been enabled to attain and to support among the nations of Europe; the conflict she supported single-handed, it may be said, against the world; the wealth and riches with which she overflows; and when we consider that all this could never have been attained but for the labours, the inventions, and the improvements of our mechanics, we are surprised, and feel ashamed for our country, that no mode of permanently and effectually rewarding humble merit has ever yet been established. Often has it been thought of—often has it been proposed; but never yet has any thing effectual even been attempted. We see inventive genius and persevering industry pining around us in poverty and obscurity, and dying the victim of grief and despair, unpitied and uncared for. This is surely unworthy of a great nation; and most sincerely do we pray that some plan may be adopted which will prevent in future this disgrace to Britons. Among the many who have been sufferers by pursuing the public good rather than their own private emolument, none surely is more worthy of patronage—none more worthy of reward, than Mr. Henry Bell of Helensburgh.

Much discussion has taken place in the public journals as to who was the first to apply the power of steam to the propelling of boats; but whoever was the first to give the hint, or to attempt its execution, it is not to be disputed that Mr. Bell was the first to put the principle in practice, and to bring steam boats into general use. It was he *who gave the model* to Mr. Fulton, who has received so much of the fame arising from the introducing this mode of conveyance, and he even went over to America with that gentleman, for the purpose of assisting in establishing them.—This is fully established by the following extract from the House of Commons on the subject:—" But the whole merit of constructing these steam boats is due to the natives of Great Britain. Mr. Henry Bell, of Glasgow, gave the first model of them to Mr. Fulton, and went over to America to assist him in establishing them." Thus, we see, this ingenious man has not only benefited Britain by the introduction of steam boats, an improvement in inland navigation, at any rate, of incalculable value, and now likely to be useful even in navigating the great seas,—but he was also the benefiter of America, as it was he who introduced them in that country, where they have so long been productive of so much benefit. But besides this, Mr. Bell first introduced the locomotive engines, which have been found so very useful at Newcastle. And what has his ingenuity produced to him, while it has thus benefited not only his native country, but indeed the whole world?—Poverty and sickness!—This has, we may say, been his sole reward. The Magistrates of Glasgow, no doubt, most laudably gave him an annuity of £50 per annum from the funds of the city; and to this he is well entitled, considering the benefit the city has received from his labours and his ingenuity; but although this is probably as much as the Magistrates of Glasgow consider themselves entitled to award from the city funds, it is by no means an adequate reward to Mr. Bell. Something national ought to be done: something which

will effectually relieve him from the difficulties under which he has too long laboured, and which would enable him to go on with ease and freedom, in the prosecution of his improvements on the steam carriage, which may yet be as useful to the world as his steam boats have been. We give from the Manchester Guardian Mr. Bell's own account of his improvements, and we trust something will be done for his relief.

Sir,—I had a call from one of Mr. Wyld's partners two days ago, informing me that you wished a short account of my first outset with steam boats. I suppose you mean in this country? But I claim the merit of being the person that put them first in practice in this or any other country; which fact cannot be denied me. I refer you for a more particular account to the fifth report of the honourable House of Commons. In addition to what is there stated of my inventions, I have to add, that I was the first that made locomotive engines to be of use on land, and there is a number of them in the coal-works at Newcastle. I also made a steam carriage to ply on a common turnpike road, and it did well; but it was a high pressure engine, which, for the safety of the lieges, are prohibited by Act of Parliament. If it were not for the risk that attends high pressure engines, they could be made to travel at the rate of nine miles per hour, on good, ordinary, and even on up-hill roads. But let me now turn your attention to the progress of steam boats in Scotland since their first commencement.—In 1811, I built the Comet, and plied her between Glasgow and Greenock; but the prejudice was so great against steam boat navigation, by the hue and cry of the fly-boat and coach proprietors, that for the first six months very few would venture their precious lives in her; but in the course of the winter of 1812, as she had plied all the year, she began to gain credit, as passengers were carried 24 miles as quick as by the coaches, and at two-thirds less expense, besides being warm and comfortable. But even after all, I was a great loser that year.—In the second year, I made her a jaunting-boat all over the coasts of England, Ireland, and Scotland, to show the public the advantages of steam boat navigation, over the other mode of sailing. I have done what no Emperor, King, Prince, Admiral, or General could do; I have made vessels go against both wind and tide, which no man could do before. I erected several other steam boats, and opened up the most of the different stations where steam boats ply, and all this single-handed. I sold the first steam boat that went to London, and also the first that went to France. The Comet was lost in 1820, December 15th, on the west coast of Scotland, hands and passengers all saved.—On the 9th of September, 1821, another steam boat of mine was burnt down to the water's edge, on a Sunday morning, lying at anchor; neither of the two were insured; and, independent of this, I experienced a great loss in opening up all the different grounds single-handed, which, as soon as they were seen to pay, induced large and powerful companies to embark in steam boat speculation with larger boats and greater power, so that they could go quicker, and of course your humble servant and his steam boats were left behind; for the public do not sacrifice their own conveniences in order to reward the man to whom they are indebted for an invention.

I have, in my day, done a great many public works in Scotland, and a few in other countries; but I have almost served my day and genera-

tion; as my supply of fuel is now getting small, my steam is getting weaker,—and, at last, my capacity of making way must cease. I have been these six months laid up in dock under repairs; but should the head carpenter give the order that all is right, I may once more be launched afloat. If this should be the case, I will make a voyage to see my friends in London, as I intend to apply the ensuing session to the House of Commons, to see if there is as much gratitude in the representatives of the people as will induce them to grant me a recompence for the good that I have done the nation at large. In a few years, I have no doubt, the whole of the coasting trade will be carried on by the power of steam. I have also no doubt of the practicability of a steam vessel communication with the East Indies. The vessels I would recommend for this purpose should be about 400 tons burden. Their course ought to be straight up the Mediterranean, then to cross the narrowest neck of land to the head of the Red Sea, to meet other steam vessels, and then proceed to Madras; which voyage could be performed in 35 days, including four days for taking in fresh provisions, water, &c. I will venture to affirm, that history does not afford an instance of such rapid improvement in commerce and civilization as that which will be effected by steam vessels; and one sees its commencement now in the promiscuous multitude which is collected together in one of these commodious and expeditious conveyances. There, people of every nation, and every tongue, meet together in amity; every one inquiring into the manners, languages, and customs of each other, and not one word of discord amongst the mixed multitude. It may almost be said, it is a gathering in of the nations to harmony with each other, in love and unity, peace and accord.

At the end of 1823, there had been built in Scotland about 95 steam boats, the cost of which will average about £4000 each. Sunk capital is £380,000. Of that number there have been forty sold from the ports of the river Clyde, that were built and finished there. Last year, no less than 55 steam vessels were plying in Scotland, 32 of them belonging to the Clyde. Suppose these 55 steam vessels employ 550 men, allowing ten men to each vessel, their wages at the average of 30s. per week, (including captain and steward's wages,) will amount to £32,175 0 0

Suppose the average consump. of coals to be four tons per day, for 30 weeks in the year, at 12s. 6d. per ton.........	32,175 0 0
Harbour dues.........	6,500 0 0
Ten per cent. tear and wear, on 55 steamboats.................	22,000 0 0
And ten per cent. profit on the capital invested, is............	22,000 0 0
So that the annual receipts ought to be	£114,850 0 0

If we suppose that each passenger pays 4s. the number of passengers in one year will be 574,250! This shows you the commerce by steam-navigation in Scotland, for which the public is in a great degree indebted to your most obedient and humble servant,

Henry Bell.

SIR HUMPHRY DAVY'S METHOD OF PROTECTING COPPER SHEETING FROM CORROSION BY SEA WATER.

[As it appears that many of our readers are not aware of the nature of Sir Humphry Davy's plan for protecting the copper of ships, on which, last week, we offered some observations, although from the discussion which has of late taken place about it, we thought it had been pretty generally known, we have been induced to give an account of it.]

The distinguished President of the Royal Society, had long ago shown, that the chemical action of bodies upon each other may be modified or destroyed by changes in their electrical states; that substances will combine only when they are in different electrical states; and that by bringing a body naturally positive, artificially into a negative electrical state, its usual powers of combination are altogether destroyed. By reasoning upon this general principle, which had previously conducted him to many brilliant discoveries, Sir Humphry was led to the discovery which we propose at present to explain. Copper being a metal only weakly positive in the electro-chemical scale, he conceived that it could only act on sea water in a positive state, and, consequently, that if it could be rendered slightly negative, the corroding action of sea water upon it would be destroyed. After many trials, he obtained the most satisfactory confirmation of these theoretical views. A piece of zinc as large as a pea, or the point of a small iron nail, preserved 40 or 50 square inches of copper from corrosion, whether it was placed on the top, bottom, or on the middle of the sheet of copper, and whatever was the shape of the copper. Every side, every surface, and every particle of the copper continued bright while the zinc or iron was slowly corroded.

A piece of thick sheet copper, containing about 60 square inches of surface, was cut so as to form seven divisions connected only by the smallest filaments, and a mass of zinc, of the fifth of an inch in diameter, was soldered to the upper division. The whole was plunged under sea water, and after the lapse of a month the copper was as bright as when first introduced, while similar pieces of copper undefended had undergone considerable corrosion.

The application of these results to the preservation of the copper sheeting of ships of war and other vessels is obvious. Under the sanction of the Lords Commissioners of the Admiralty, Sir Humphry has been engaged in ascertaining the value of this discovery upon ships of war, and that with the happiest effect. Sir Humphry has, we believe, found that the defended copper is more liable to become foul by the adhesion of barnacles, weeds, &c. than the undefended, because the oxide on the latter poisons the animals, whereas the clean metallic surface does them no harm. It will be necessary, therefore, as we believe Sir Humphry has suggested, "to weaken the defensive action by diminishing the extent of defending surface to such a point as to allow a slight oxidation of the copper sufficient to repel the animalculæ, but not sufficient to occasion a serious waste of the metal."—*Ann. of Phil. Aug.* 1824. In another paper, our author proposes to describe other applications of the principle to the preservation of iron, steel, tin, brass, and various useful metals.

We cannot conclude this notice without adverting to a most singular attempt which has been made to deprive this eminent philosopher of the merit of his discovery; an attempt, however, which, except among the ignorant, can have no other effect than to exalt the genius of the individual whom it is meant to injure. Because Mr. Charles Wyatt of Birmingham took out a patent in 1791 for tinned copper sheets, and recommended *tinned copper* for the sheathing of *ships*, on account of the tin resisting the action of salt water, it is therefore boldly averred, that Sir H. Davy's invention is not original. Those who wish to read an answer to this ridiculous claim, may consult the *Ann. of Phil. Aug.* 1824, p. 141. Sir Humphry Davy's paper is printed in the *Phil. Trans.* for 1824, No. I. page 151—159.

ON THE REVIVAL OF THE INSCRIPTIONS ON COINS AND MEDALS BY UNEQUAL OXIDATION.

It has been long known, though we have not been able to ascertain to whom we owe the discovery, that a coin, from which the inscription and the figures have been entirely effaced, so as not to present the slightest trace of an impression, may have the inscription and figure partly or wholly restored, by placing it upon a hot iron. In order to perform this experiment with the fullest effect, the coin employed should be one equally worn down, and in which very little of the metal has been worn off the hollow parts by which the letters are surrounded.

When a coin of this kind, or what is still better, a coin on which an illegible trace of the letter still remains, is placed upon a heated iron, it will be seen that an oxidation takes place over its whole surface, the film of oxide changing its tint with the intensity or continuance of the heat. The parts, however, where the letters of the inscription had existed, oxidate at a different rate from the surrounding parts, so that these letters exhibit their shape, and become legible in consequence of the film of oxide which covers them having a different thickness, and therefore reflecting *a different* tint from that of the *parts adjacent*. The tints thus developed, sometimes pass through many orders of brilliant colours, particularly *pink* and *green*, and settle in a bronze, and sometimes a black tint, resting upon the inscription alone. In some cases the tint left on the trace of the letters is so very faint that it can just be seen, and may be entirely removed by a slight friction of the finger.

When the experiment is often repeated with the same coin, and the oxidation successively removed after each experiment, the film of oxide continues to diminish, and at last ceases to make its appearance. It recovers the property, however, in the course of time. When the coin is first placed upon the heated iron, and consequently, when the oxidation is the greatest, a considerable smoke rises from the coin, and diminishes like the film of oxide by frequent repetition. A coin which had ceased to give out this smoke, smoked slightly after twelve hours exposure to the air, having been removed from the hot iron at the beginning of that interval, and replaced upon it at the end of it by a pair of pincers.

From a great number of experiments, I have found that it is always the *raised* parts of the coin, and in modern coins the elevated ledge

round the inscription, that oxidate first. This ledge in an English shilling of 1816, began by exhibiting a brilliant yellow tint before it appeared on any other part of the coin.

In examining a number of old coins, a brilliant red globule, accompanied with a smell of sulphur, appeared on one or two points of the coin; and sometimes small globules, like those of quicksilver, exuded from the surface. Other coins exhaled a most intolerable smell; and an Indian pagoda became perfectly black when placed upon the heated iron.

Such being the general facts respecting the oxidation of coins, it becomes an interesting inquiry to determine its cause. If we take a homogeneous and uniform piece of silver, and place it upon a heated iron, its surface will oxidate equally, if all the parts of it are exposed to the same degree of heat. A coin, however, differs from a piece of silver of uniform texture, as it has been struck with great force during the act of coining. In this process the sunk parts have obviously been most compressed by the prominent parts of the dye, and the elevated parts least compressed, the metal being left as it were in its natural condition. A coin, therefore, is a piece of metal in which the raised letters and figures have less density than the other parts, and consequently these parts oxidate sooner, or at a lower temperature. When the letters themselves are rubbed off by use, the parts immediately below them have also less density than the metal which surrounds them, and consequently, they receive from heat an oxidation and a colour different from that of the surrounding surface. Hence, the reason is obvious, why the invisible letters are revived by oxidation.

A similar effect takes place in the beautiful oxidations which are produced on a surface of polished steel. When the steel has hard portions, called *pins* by the workmen, the uniform tint of the oxide stops near these points, which always display colours different from the rest of the mass.

The smoking of the coin, the diminution of its oxidating power, by a repetition of the experiment, and the recovery of that power by time, seem to indicate that the softer parts of the metal absorb something from the atmosphere which promotes oxidation. Whether this is oxygen or not, remains to be determined.

ON THE NEW VOLTAIC-MECHANIC AGENT.

[We now present our readers with the remainder of the article from the Chemist, for which we could not find room in our last. G. M., the original discoverer of this new Galvanic Mechanical power, very justly remarks, that the Editor of the Chemist does not relinquish his claim to the discovery with any very liberal feeling; but, for his own sake, G. M. thinks the Editor "should have observed a little more consistency. In his first article he says he never could be enough thankful that it was his lot to make the discovery, and in the present article he says that he has no great ambition to be celebrated as a discoverer," &c.]

VOLTAIC-MECHANIC POWER.

"We had no intention of again adverting to this subject at present; but we are in some measure compelled. An ingenious friend has drawn our attention to No. LL of the

Glasgow Mechanics' Magazine, in which we are indirectly accused of having appropriated to ourselves the invention of another. On turning to No. XLIII. of this work, published on October 23, in which this invention is recorded, we found the following article.

[Here the writer quotes the article from our Magazine, No. XLIII. Vol. II. to which we refer the reader.]

The article on "A New Voltaic-Mechanic Power," published in the Chemist, did not appear till November 20, and consequently the merit of priority as to the idea of employing the *decomposition of water by galvanism*, and its recomposition to produce a Mechanic Power, belongs, as far as we are concerned, to the writer in The Glasgow Magazine. We have indeed since been informed, that the same idea had occurred long before to a very ingenious gentleman of this metropolis, who had instituted a series of experiments on the subject, and that the merit of having first thought of the subject, does not belong to the writer in The Glasgow Magazine. This point, however, we shall leave to be settled between the writer in the Magazine and this gentleman, if he shall ever think proper to assert his claim, it being enough for our purpose to concede his priority over ourselves. But while we cheerfully acknowledge this, and have now done all in our power to make it known to the public at large, we must solemnly assert, for ourselves, that we never read the paper in the Glasgow Magazine till within this week, and never either heard or saw the least word which could lead us to suppose the idea of a Voltaic-Mechanic Power had previously occurred to any other person. On the contrary, on mentioning the matter to two gentlemen well acquainted with the subject, they assured us, though they both doubted the utility of the project, that it was quite novel. As the writer in The Glasgow Magazine states, it was invented over again. It was from contemplating the perpetual reproduction of electricity in the *pile*, and seeing the decomposition of water by that electricity, that we were led to suppose Voltaic electricity might be employed as a mechanic agent. Our project was formed in perfect ignorance of the Glasgow man's scheme. We have no wish to plume ourselves with borrowed feathers, or to take, without an acknowledgement, the discoveries of another. We are, indeed, not greatly ambitious of being celebrated discoverers, because we know that every really valuable discovery belongs at all times more to the age than the individual; and had we known any other person had hit on the same thought as we set forth, we should have been glad to have supported our views by his observations. A man may doubt the feasibility of those projects he himself forms, but when he finds they are also entertained by another, it is a strong reason to believe they are both practical and just. In conclusion, we again deny having had any knowledge whatever of the article we have now inserted till within this week, and claim for ourselves the merit of having, like the author of that article, blundered on a discovery."

ON VOLCANOES.

It is not a little amusing to peruse the various ridiculous and untenable theories with which talented and clever men have, from time to time, amused themselves and the world, on many subjects, and no more so

than on the subject of volcanoes. In No. LV. Vol. II. we gave an account of one of these; and we will now proceed to give other theories which have been equally powerfully supported, and which will be found, all of them, to be equally untenable. Werner, who had studied the extraordinary appearances produced on superincumbent rocks by the combustion of beds of coal, applied these facts to the explanation of volcanic fires, and supposed that lavas were formed by the fusion of basalt. This opinion has certainly considerable plausibility; but, when it is examined, it is found to be absolutely incapable of accounting for the duration of volcanoes, for their intermittance, or for their various operations.

Still less probable were the opinions of the philosophers who recurred to petroleum, and to sulphurets of iron. Breislac, who, like most men of very extensive observation, is little addicted to theorising, has been rather unfortunate where he has attempted it. He finds nothing incongruous in the joint action of coal, pyrites, and petroleum. He discovers a bed of coal, a foot thick, near Beneventum, which he regards with much exultation; though he might as well think of feeding a furnace with a sheet of paper, as of stimulating a volcano by such a supply. By decomposing his pyrites, he distils petroleum from limestone of the Appenines; it carries with it some phosphoric matter, (created expressly, of course,) and finds its way to commodious reservoirs under Vesuvius. There, water, saturated with common salt, waits to receive it, and their union is cemented by the hymenial torch of electric flame. The usual consequences of matrimony, discord, fury, and uproar, ensue; and the unnatural parents turn out of doors the lava they engender between them.

Theorists, who thus endeavoured to account for the inflammation of Vesuvius, were much embarrassed to obtain the necessary supplies of oxygen. Dr. Thomson, whose residence at Naples afforded him ample opportunities of observation, and whose acute genius has, in several instances, thrown light on volcanic operations, has devised an explanation of this difficulty, more remarkable for its boldness than its probability. He supposes that, at certain degrees of heat, the oxygen contained in the carbonic acid of the limestone of the Appenines, may be inclined to enter into new combinations; and he illustrates this doctrine by the beautiful and well-known experiment of Tenant, who operated the decomposition of carbonic acid by means of phosphorus.* On this theory, it may be observed, that it commences by supposing the previous existence of a heat of great intensity, without providing any means for its production. Secondly, it supposes the application of some unspecified base to the carbonic acid, to attract the oxygen; he cannot possibly suppose the phosphorescent limestone to contain phosphorous enough for this purpose. Thirdly, it affords no employment for the charcoal of the carbonic acid, which is left to crystalise into diamonds, plumbago, or what it likes best. Fourthly, there is no way of disposing of the immense quantity of quick-lime which this process would produce; part of it may be incorporated with the lavas, but the whole cannot be employed in this way, without rendering their basis almost entirely lime, which is notoriously not the case.

But the palm of superior origi-

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* Giornale Letterario di Napoli, vol. cvi. p. 3.

uality, in this contest of theoretic invention, must be accorded to the genius of M. Patorin, who is advantageously known to the world by his travels in Siberia, and his splendid collection of Siberian minerals. In an essay read at the French Institute, and afterwards published by him in a separate form, * he procures muriatic acid from common salt, by a rather arbitrary process, and decomposes pyrites by its means. He supposes sulphur to be concrete electricity, and then identifies it with phosphorous. He manufactures calcarous earth from thunder and lightning; and he discovers a metalliferous fluid, which is at once the base of the muriatic acid, and the generator of metallic veins. It assists phosphorous in fixing oxygen under an earthy form; and, with the united aid of the other substances we have enumerated, he very successfully accounts for every existing phenomenon. On this theory, we do not presume to offer any observations.

* Recherches sur les Volcans.

ON THE INVENTION, PROGRESS, AND ADVANTAGES OF THE ART OF ENGRAVING IN MEZZOTINTO UPON STEEL. By Mr. Charles Turner.*

No. 50, Warren Street, Fitzroy Square, London, 14th October, 1824.

Sir,—The discovery of a method of engraving in mezzotinto upon steel may be justly regarded as one of the most fortunate occurrences in the history of the graphic arts. In the infancy of this invention, as in that of almost every other, difficulties repeatedly presented themselves; but these have been successively overcome; and the art, an outline of the gradual advance of which I am about to subjoin, may at present be considered as arrived at a state of full and vigorous maturity.

In the year 1812, that distinguished ornament and benefactor of his country, the late Mr. James Watt, suggested to me the possibility of engraving in mezzotinto upon steel; but all the attempts with which I immediately followed up the communication were unsuccessful. The hardness of the steel induced me to lay that metal wholly aside; and some experiments which I subsequently made upon plates of brass were attended with no better results; these latter substances were so unequal in their temper, that I found them quite unfit for my purpose.

It was not, therefore, till the very recent date, when Mr. Jacob Perkins, (whose indefatigable labours and extraordinary inventive powers are so well known and so highly appreciated,) had produced blocks of steel soft enough to receive the impressions of our tools, and form a ground upon which we have been able to accomplish every thing required, that the art of engraving in mezzotinto upon steel can be said to have had its commencement.

In the month of January, 1820, Mr. Say made an engraving on one of Mr. Perkins's blocks, and it was decidedly the best specimen then produced. In February 1821, I engraved a portrait on the first steel-plate I ever saw. It had been given to me by the late Mr. Lowry, and it turned out so satisfactorily as to meet the approbation of Sir Thomas Lawrence.

On the 30th of May, 1822, Mr. Lupton received the gold medal

* From Vol. XLII. of the Transactions of the Society for the Encouragement of *Arts, Manufactures*, and Commerce.

from your Society for his admirable performance, the Infant Samuel. From the good fortune which has crowned the latter experiments, steel-plates have obtained a decided preference over those of copper for engraving in mezzotinto; and the beautiful specimens now before the public, from the hands of Messrs. Ward, Reynolds, Say, Lupton, and other artists, require only to be seen to be admired.

In engravings in mezzotinto upon steel, the tones are far better defined than those obtainable upon copper. From the superior density of the former metal, the clearness of the lighter tints is carried to much greater perfection; and, from the same cause, the darks have also a decided preference, being distinguished by their superior richness. The advantages in these respects are so numerous, that all the deficiences, which were formerly irremediable in mezzotinto engraving, are now entirely mastered; and the numerous difficulties, with which the artist was always contending, completely dissipated: although the process is much longer and more tedious on steel than on copper; yet, when completed, it is so perfectly satisfactory as fully to reward the additional labour. The instruments used in engraving in mezzotinto upon steel, are precisely the same as those employed in engraving upon copper. When a deep black is required, twice the number of ways will be found desirable: from sixty to a hundred will not be too many. Steel-plates are now so well prepared, and are become so common, that they are easily obtained by all who desire them: the best are those manufactured by Mr. Rhodes and Mr. Hoole, of Sheffield, who have paid every attention to rendering them fit for the purpose of the artist: they may also be had of Mr. Harris, Shoe-lane, London.

I believe that I shall not be thought to entertain an erroneous opinion, when I express my belief that it is solely to the introduction of engraving upon steel into this country by Mr. Perkins, that we are indebted for the present successful application of the same metal to the art of engraving in mezzotinto.

In conclusion, it may be serviceable to add a warning and receipt, which the novelty of the use of steel in the art of engraving somewhat imperiously requires:—Great care should be taken to save the steel from rust, which is done by warming the plate, and rubbing sheep's suet (from the animal) over it, and keeping it near a fire, or in a dry room: without this precaution much mischief will arise.

I am, Sir, &c. &c.

C. Turner.

To A. Aikin, Esq. Sec. &c. &c.

QUERIES, &c.

To the Editors of the
Glasgow Mechanics' Magazine.

Gentlemen,—At this time, when men feel the great advantages arising from the use of the steam engine; when every hand is open towards the erection of monuments to the memory of its great improver; and every man rests assured that, in so doing, he assists to perpetuate the name of one of the greatest benefactors of our country, it is matter of surprise that its powers are not more minutely calculated, and that no treatise has appeared, exhibiting, at one view, to the practical engineer, the due proportion of its various parts: conceiving that the following question is of some importance, its solution,

by any of your numerous correspondents, will much oblige,

Gentlemen,

Yours, &c.

B. R. D. R.

Is there any loss of power in the use of the crank, accompanied by a fly-wheel,—and what loss is there in its use when unassisted by the fly?

Glasgow, 31st Jan. 1825.

A Lozenge Maker wishes to know the best and simplest receipt for making a yellow, a red, and a purple colour, that would assist him in his profession.

W. B. requests to be favoured with an exact description of the Magic Lanthorn.

A Receipt for making Brandy.

One pint of whisky; one pennyworth of Iris-root, pounded; half a gill of the spirit of sweet nitre; one gill of red wine; six prunes, pounded; two ounces of burnt sugar; and a little green tea. After remaining twenty-four hours, it is ready for use.

LONDON MECHANICS' INSTITUTION.

If this institution does not succeed, it will not be for the want of finances. We with pleasure observe, that Sir Francis Burdett has added to his former splendid subscription one thousand pounds; and numerous other subscriptions, equally liberal, the situation of the donors considered, have also been recently added, amongst which we observe those of Jeremy Bentham and John Cam Hobhouse, Esquires, £100 each; the Rev. G. Atwick, £50; Dr. Gilchrist, £10; H. Bickerstith, Esq. £10; and G. P. Greenwich, £10. Most of these, including the larger ones, are second subscriptions. May the excellent example be extensively followed,—and may similar patronage be extended to all parts of the kingdom,—that every institution established, or now establishing for the like laudable purpose, may be supported by the munificence and liberality of those who are best able—the wealthy of the country.

Electrical Phenomena accompanying Combustion.—M. Becquerel found, that on rolling up a sheet of paper, placing it in the electrometer, inflaming it, and touching the flame with a piece of wet wood, that the electricity might flow away more rapidly, the paper became positively electrical. If the experiment were inverted, the paper being held in the hand, and the flame made to touch the piece of wet wood placed on the electrometer, it was found that the flame took negative electricity. Hence it may be concluded, that when paper is burnt, the paper becomes positive, and the flame negative. If alcohol be burnt in a copper capsule, it is found by the condenser that the capsule becomes electrified positively.—*Ann. de Chim.* xxvii. 14.

NOTICES TO CORRESPONDENTS.

Communications received from A. B., Messrs. Henry Bell, Hugh Barclay, W. Warren, G. M., &c.—Norais will oblige by forwarding the paper he profers. His query will appear next week.

☞ We are sorry Mr. Barclay has felt offended at the letter of Aliquis in our last. The hurry inseparable from getting up a weekly publication, made us overlook certain expressions till it was too late; which, had they been previously noticed, would have prevented its publication in our pages.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of Steuart & Panton, Cheapside, London; and Edward West & Co. Edinburgh.

Curll, Printer

INDEX TO VOL. II.

LIST OF THE ENGRAVINGS ILLUSTRATIVE OF THE SECOND VOLUME.

END OF VOL. II.

JAMES CURLL, PRINTER, GLASGOW.